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THE TELEGRAPHIC JOURNAL AND

Electrical Review.

VOL. XXII.—No. 539.

EXETER ELECTRIC LIGHT COMPANY.

INSPIRED by the seeming success at Taunton, some of the prominent citizens of Exeter have been displaying great interest in the electric light, and as a result we have had to notice the formation of the Exeter Electric Light Company. The prospectus of the company is now before us. Mr. Massingham, the leading spirit in the Taunton enterprise, is to be managing director at Exeter, and Messrs. Laing, Wharton and Down, of course, will be the consulting electrical engineers. It is natural that the dividend paid at Taunton should figure as an inducement to the people of Exeter to become shareholders; but we should feel a little easier in our minds if Mr. Massingham, not usually a reluctant correspondent, had responded to our invitation to explain the circumstances which led to so low a sum appearing against salaries in the balance sheet of his company. We have very little doubt as to the ultimate and early success of the Taunton, or indeed of the Exeter, company. As far as we can see, there have been none of those heavy charges for no tangible property which so sadly crippled the pioneer electric lighting companies; there is the assurance of a continuous contract in the first case with the Corporation, and there is a growing demand for the electric light amongst shopkeepers of the town. Still it is far better to have everything clear and beyond cavil, and the allegation that the dividend at Taunton was only arrived at by stinting the responsible officers of the company deserved answer. In Exeter, even though street lighting may not be immediately entered upon, there is an awakening desire for the light which has rendered Taunton famous throughout the west; and shopkeepers as well as private individuals are pretty sure to make use of it to an extent which will make the venture remunerative to the newly-formed company. The names which appear on the Exeter prospectus as those of the directors are well known and of great influence in Devonshire, and we have no doubt whatever that this will be an honest, straightforward endeavour to make electric lighting pay. Exeter, as the prospectus points out, has exceptional advantages for the purposes of electric lighting in its ample and easily available supply of water, and the right to use the water power at Trew's Weir to the extent of 100 effective H.P. has been secured in perpetuity at a price which, when compared with the cost of steam power, is said to be very low. The land upon which the buildings and machinery are to be erected, and which has an extensive water frontage, has been secured upon easy terms, shares being taken by the vendors to the full amount of the purchase money. Over 170 citizens have given definite promises to become customers, and a largely-signed memorial is awaiting presentation to the Town Council advocating the adoption of arc lighting for the streets, this movement being the outcome of a largely attended and enthusiastic public meeting which we recently reported. It will thus be seen that the Exeter Electric Light Company has a very promising outlook at the start. Good business management and thoroughness in carrying out practical details, so that breakdowns may not occur to lessen the admiration or damp the enthusiasm of the ardent Devonians, should in a very short time make the undertaking an assured success.

We have bestowed plenty of commendation upon this scheme, and its promoters will therefore forgive us if we do not conclude our remarks without one little quibble. Whatever idea have "the proprietors of the Thomson-Houston system" got into their heads that they should make a pretence of selling to the Exeter Company the *right to purchase* lamps and machinery from them? It is true, payment for "the license to use their patent rights" is to be taken entirely in shares; but the arrangement seems a little peculiar, and we should like some further information about it—as to the number of shares, for instance, which the Thomson-Houston people are to take for their license, and why a license is necessary at all. The capital of the company consists of 2,000 shares of £10 each, and 10 out of the 2,000 are founders' shares.

UNDERGROUND CONDUCTORS.

THE New York *Electrical Engineer* for the current month contains several articles dealing with the question of underground conductors for electric lighting. On glancing through these articles we find that Mr. Leggett devotes nearly the whole of his paper to condemning the placing of arc light conductors underground, citing, in proof of his argument, the failures in many large cities consequent upon attempts in this direction. Mr. Jesse Smith confines himself almost exclusively to the comparative merits of lead and iron pipes, and of wooden troughs and ordinary conduits. He deprecates the employment of poorly insulated wires. Prof. Elihu Thomson calls attention to the conditions to which underground wires are subject, and points out that the qualities essential to them must be, exclusion of moisture, high insulation, mechanical efficiency, durability, hardness, and toughness. Mr. Carpenter Smith advocates high insulation, and condemns the employment of underwriters' wire. Mr. Barton, in speaking upon the relation between electric lighting and fire insurance, censures false economy and recommends good materials and workmanship.

Throughout these articles we can find no criticism of any particular method of insulation, no definite statement of what materials were used for the purpose, nor do we notice any recommendation as to the systems which would offer the greatest advantages under various circumstances. Such an omission is to be greatly regretted, for the value of the papers is to a great extent neutralised by it.

At the meeting of the National Electric Light Assotion on February 23rd, Prof. Forbes in speaking of underground conductors for electric lighting, said that in England a much higher insulation was adopted than in America; that the best possible insulation was afforded by India-rubber and several servings of tape, and that an excellent example of this system was to be seen in the installation of the Grosvenor Gallery central lighting station. He remarked that although he was a partisan of high insulation since he had been in the States, he thought it possible that in the question of high and expensive insulation the matter had been overdone in England. In the course of his remarks Prof. Forbes stated that the best underground wires he knew of were employed by the India-Rubber, Gutta-Percha, and Telegraph Works Company in its works at Silvertown, where the underground mains served a large arc light installation. The conduits were not watertight, the leads being consequently sometimes dry and sometimes wet, yet for six years these conductors had never caused the least trouble.

WE are pleased to see that the course of lectures on Dynamos, now being given by Prof. Perry at Finsbury Technical College, is very well attended. The lectures are given in the theatre in which the Principal gives his electrical engineering course, and not only is it crammed from floor to ceiling, but many of the listeners have to be contented with a seat on the steps. The lectures are illustrated by a collection of dynamos and pieces of dynamos lent by the leading manufacturers.

THE specimen of cable to which Mr. David Brooks draws attention in his communication to us may be seen at our office by anybody interested in underground conductors. As the subject is one which will probably lead to further correspondence, we withhold any expression of opinion on the method of insulation.

WHAT gave rise to the assertion which has been frequently made that the Brush Corporation would have sustained a loss upon its contract with the City if its tender had been accepted? Amongst a great deal of glorification of the "grand old City" and its wonderful corporation and other similar twaddle, some members of the Bishopsgate Ward Club last week took upon themselves to deliver oracularly upon this subject of the City lighting, and the chairman, a Mr. Cherry, said the Brush Corporation proposed to erect 200 lamps at a considerable loss upon each lamp; this he considered a bribe thrown out to the City, for which the shopkeepers and other consumers would have to pay. We are aware of no authoritative statement emanating from any of the Brush officials which would bear the construction that the street lighting would have been conducted at a loss at the price given; indeed, we received quite an opposite impression from the remarks of Lord Thurlow to his shareholders a fortnight ago, for he spoke distinctly of a profit—a small one, or what he termed a mere tradesman's profit, but a profit nevertheless. Some of these wise corporators, whilst desiring that the electric light should be adopted (one, by the way, was afraid it would prove injurious to the eyesight—had heard that compositors would not work by it! "Oh, ye gods, what a glorious twist" in that man's mind!), were anxious that no monopoly should be given to any one company. This anxiety, we presume, has reference to the private lighting, for the lighting of the streets can only be carried out under contract with the City Corporation, who, we imagine, do not wish to see the same area lighted by two or three different companies. With regard to the monopoly in private lighting, that, too, can only be obtained by the consent of the City authorities, who surely possess rights and powers sufficiently strong to prevent any injurious operation of the permission it gives. It will be a little hard to separate the two classes of lighting, so as to make the license for opening streets, laying or tapping mains, and so on, for domestic lighting purposes, a consideration quite apart from and outside the contract for the public lighting. At any rate, if they do that, they will have to pay more for the electric light in the streets.

THE fact that overhead wires have suffered to only a comparatively slight extent by the gales of the past two weeks should be a sufficient answer to the croakers who predicted repeated disaster in rough or snowy weather. We have had high winds and we have had heavy snowfalls, yet the wires remain, and the instances of interrupted communication are remarkably few. This proves what we have repeatedly asserted, that it takes an exceptional combination of untoward circumstances to cause a general destruction of wires like that which occurred in the last few hours of 1886. No doubt the new erections after that terrible experience were more carefully planned and carried out, but there is the obvious conclusion plain enough that overhead wires may be run in such a manner as to withstand the influences of ordinary atmospheric and climatic disturbances.

IN its issue for March 16th, *Industries* has a short article on the subject of overhead wires for electric lighting. Attention is called to the fact that in America, while it has been found perfectly feasible to supply incandescence lighting by means of underground mains, all attempts to supply arc lights in the same manner, have proved unsuccessful. The failure is attributed, primarily, to the difficulty of insulating cables laid underground, and our esteemed contemporary takes a very gloomy view of the situation. It must be remembered, however, that cheapness is as a rule the principal object aimed at in many, if not most, of the installations in the United States; and in the one or two exceptions to this almost general rule, where really well insulated and efficiently protected conductors have been put down, we read that most satisfactory results have been obtained. We have already had occasion to point out the futility of expecting thorough and permanent efficiency when the system adopted affords the conductors an insulation and a mechanical protection totally inadequate when the work to be done by them, and the positions they are placed in, are taken into consideration. One might pertinently ask what would be thought of a railway system in which the expense was unstinted with regard to locomotives and stations, yet where the work of laying the metals and building bridges was altogether entrusted to unskilled labour, unsuitable material being at the same time employed.

THE Exchange Telegraph Company is anxious to increase its facilities for the transmission of news, and this week sought the permission of the Commissioners of Sewers to run wires from the subway under the Thames Embankment to its Fleet Street office, by way of Whitefriars Street and Crown Court. The company was backed up in its memorial by a number of editors and proprietors of newspapers, many of whom are entirely dependent upon its wires for their Parliamentary intelligence. The wires were to go underground, so the old outcry against dangerous and unsightly wires overhead could not be revived. But the City Fathers have become wonderfully cautious, and they declined to grant permission forthwith, as instigated by one of their number. It was "a matter for consideration," and they referred it to the Streets Committee.

THE English Consul at New Orleans attributes the enormous destruction of cotton mills by fire mainly to the neglect of obvious precautions. A curious statement in his report is that latterly a new danger has been added by the electric lights, the glasses of which are constantly broken, "so that the sparks occasioned by a temporary derangement of the connections are blown about amongst the cotton bales." More faulty workmanship, doubtless; but the information is extremely vague.

YES, bad workmanship has a great deal to answer for in America. There is plenty of it in England, but it is seen on a larger scale in the States. Our electrical contemporaries there have latterly taken note of the importance of the subject, and have issued strong warnings. *Practical Electricity*, after giving the details of an accident at Buffalo, whereby a man and a horse were killed by coming into contact with a broken telephone wire which had fallen across an electric light wire, sums up the matter in this style: "The question is, what wire is the Brush Electric Company of Cleveland recommending to its patrons? A company that does not care enough for the public safety to properly insulate its high tension currents ought to be boycotted. No tom-foolery in this busines is justifiable."

THE letter which we publish to-day on "Fire Office Rules" appears to be very much to the point. It is certainly desirable that with as little delay as possible a set of rules should be chosen finally and adopted as a standard. No one, however, has yet replied to the queries in our last issue. Just as we go to press a letter upon the subject reaches us from Mr. F. L. Rawson, and this we shall publish next week.

MR. RITCHIE'S Bill for the introduction of a system of local self-government in England and Wales, which, although perhaps with some few modifications in detail, will inevitably become law, supported as it is by the main body of both Liberals and Conservatives, has an interest for the electrical profession, for the powers at present exercised by the Board of Trade in regard to provisional orders under the Electric Lighting Act are by the new measure relegated to the local councils. Whether these councils would display greater wisdom than the Town Councils, Local Boards, &c., which at present exist, is a problem which time alone can solve.

A VERY interesting story of new discoveries—not in electricity, but of forms of life beneath the waters revealed by the aid of the electric light—is told in a New Orleans paper. It is known that fish are attracted by bright lights, and the knowledge of this fact has largely aided anglers and fishermen in times past. The electric light was a great acquisition in this direction, and proved very successful. Whilst the finny inhabitants of the vasty deep were being beguiled to their doom by the glare of the electric light, it occurred to Prof. Baird, of the United States Fish Commission, that he might avail himself of this development of one science for the furtherance of his researches into another. There are many fish that have never allowed themselves to be caught by any of the old methods, and he believed that there existed at a great depth in the ocean various kinds that had never been seen. At his request the steamer *Albatross*, which belongs to the Fish Commission, was provided with an engine and a dynamo. A liberal supply of heavy glass globes for 100 C.P. lamps was placed on board, together with great lengths of insulated wire and light, strong rope, and a number of heavy weights to serve as sinkers. After a few disappointments through the breaking of the globes, sufficiently strong glass was obtained, and the experiments were carried out with signal success. At a point near the Bahamas the light was dropped overboard and sunk by means of heavy weights to nearly 1,000 fathoms below the surface. It was allowed to remain in the water for some time, and was then raised slowly. It soon lit up the water for 20 feet around, and a weird assortment of fish that had never before been heard of was seen. When near the surface the entrails of some of these fish burst from their mouths. Nature had made them so that they could live in the great depths in which they were found, but when the pressure of the deep water was removed as they ascended towards the surface the counteracting internal force killed them. The dead fish were just as useful for the purpose for which the professor wanted them as live ones, and he gathered in a great many rare and curious specimens without much trouble. The light was also used to good purpose for discovering the various depths in which different kinds of fish live.

THE blocks illustrating Mr. Eickemeyer's dynamo have been courteously forwarded to us from America either from that gentleman himself or by our esteemed contemporary the New York *Electrical Engineer*, from whose pages the description is taken; being unaccompanied by any letter of advice, we can only express our thanks to one or both. A criticism on Mr. Eickemeyer's experiments on the magnetic circuit in its relation to his dynamo appeared in our issue of April 1st, 1887.

HOW does this entry in the Patent Office Journal for March 3rd affect the Edison-Hopkinson dynamo?—"Patents which have become void through non-payment of renewal fees. Non-payment of seventh year. 1880—4886, Hopkinson, J., and another. Dynamo-electric machines."

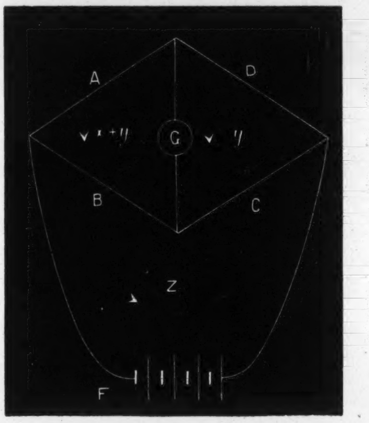
INVENTORS disposing of continental patent rights may now ask for a few thousands extra on account of Switzerland, for the National Council of that country has at length passed a Bill providing for patents for inventions. Most of our readers will be aware that there have hitherto been no patent laws in Switzerland.

KIRCHOFF'S LAWS AND THEIR APPLICATION.

By E. C. RIMINGTON.

(*Continued from page* 286.)

ONE of the most important of network circuits is that of six conductors joining four points, so that three meet at every one of these points: this arrangement is best known as the Wheatstone bridge. Let A, B, C, D, F, and G be the resistances of these conductors; the conductor, F, contains an E.M.F., e, and G a galvanometer.



To find the current through G we must take the difference between the cyclic symbols of the meshes on either side of it; now, in order to avoid the inconvenience of solving for two cyclic symbols, the following simple artifice may be adopted; call the cyclic symbol of the mesh, A G B, $x + y$, and that of the mesh, C G D, y, the current through G is now $(x + y) - y$ or x. Applying Maxwell's rule to the three meshes respectively, we obtain the following three equations:

$$(A + B + G)(x + y) - G y - B z = 0$$

$$(C + D + G) y - G (x + y) - C z = 0$$

$$(B + C + F) z - B (x + y) - C y = e$$

Rewriting:

$$(A + B + G) x + (A + B) y - B z = 0$$

$$- G x + (C + D) y - C z = 0$$

$$- B x - (B + C) y + (B + C + F) z = e$$

Hence

$$x = \frac{\begin{vmatrix} 0 & \overline{A + B} & - B \\ 0 & \overline{C + D} & - C \\ e & \overline{-(B+C)} & \overline{B + C + F} \end{vmatrix}}{\begin{vmatrix} A + B + G & A + B & - B \\ - G & \overline{C + D} & - C \\ - B & \overline{-(B+C)} & \overline{B + C + F} \end{vmatrix}}$$

$$x = \frac{e \begin{vmatrix} \overline{A + B} & - B \\ \overline{C + D} & - C \end{vmatrix}}{\Delta} = \frac{e \begin{vmatrix} A & - B \\ D & - C \end{vmatrix}}{\Delta}$$

Where Δ stands for the determinant forming the denominator.

Now if the arms, A B C and D, are so adjusted that there is no deflection in the galvanometer, $x = 0$. As Δ has its constituents formed of resistances, of which none are infinite, it must be finite.

Hence $$e \begin{vmatrix} A & - B \\ D & - C \end{vmatrix} = 0;$$ but e is not zero.

Therefore $$B D - A C = 0$$

or $B D = A C$, which is the condition that must be satisfied in order to obtain a balance. If there is not a balance:

$$x = \frac{e (B D - A C)}{\Delta}$$

Now

$$\Delta = \begin{vmatrix} \overline{A+B+G} & \overline{A+B} & - B \\ - G & \overline{C+D} & - C \\ - B & \overline{-(B+C)} & \overline{B+C+F} \end{vmatrix} = \begin{vmatrix} \overline{A+B+G} & A & - B \\ - G & D & - C \\ - B & F & \overline{B+C+F} \end{vmatrix}$$

$$= (A + B + G) \{D (B + C + F) + C F\} - G \{- B F - A (B + C + F)\} - B (B D - A C)$$

$$= G \{F (A + B + C + D) + (A + D)(B + C)\} + F (A + B)(C + D) + B D (A + C) + A C (B + D)$$

Hence

$$x = \frac{e (B D - A C)}{G \{F (A + B + C + D) + (A + D)(B + C)\} + F (A + B)(C + D) + B D (A + C) + A C (B + D)}$$

Suppose that when $B D = A C$, the arm, D, is increased by a small amount, r, the value of the latter being so small as not to appreciably affect the value of Δ.

Now when $A C = B D$, $A = \frac{B D}{C}$; substituting this for A in the value of Δ we obtain

$$\Delta = \frac{1}{C} [G \{F (C+D) + D (B+C)\} (B+C) + B \{F (C+D) + D (B + C)\} (C + D)]$$

Hence

$$x = \frac{e B C r}{\{G (B + C) + B (C + D)\} \{F (C + D) + D (B + C)\}}$$

Now it is well known that for a given coil space on a galvanometer, the number of turns of wire is proportional to the square root of its resistance. Again, the deflection is proportional to the current through it multiplied by the number of turns. Consequently the deflection is proportional to $x . \sqrt{G}$. In measuring any resistance by means of a bridge to obtain the best result the deflection due to throwing out the balance by altering one of the arms by any given small amount should be as large as possible. The problem is, then, to determine what is the best value to which the resistance of any galvanometer having a definite coil space should be wound, so as to make $x \sqrt{G}$ a maximum.

$$x \sqrt{G} = \frac{e B C r \sqrt{G}}{\{G (B + C) + B (C + D)\} \{F (C+D) + D (B+C)\}}$$

$$= \frac{\dfrac{e B C r}{F (C + D) + D (B + C)}}{\sqrt{G} (B + C) + \dfrac{B (C + D)}{\sqrt{G}}}$$

This expression is to be a maximum, and as the numerator is constant, since it does not contain G, the denominator must be a minimum; now the latter is the sum of the two terms whose product is independent of G, and therefore a constant. But it is well known that when the product of two quantities is constant their sum is a minimum when they are equal.

Therefore the deflection is a maximum when

$$\sqrt{G} (B + C) = \frac{B (C + D)}{\sqrt{G}}.$$

That is when

$$G = \frac{B (C + D)}{B + C}.$$

Now, $\frac{B(C+D)}{B+C} = \frac{(A+B)(C+D)}{A+B+C+D}$, when $AC = BD$.

Hence, to obtain the best conditions as regards sensitiveness, the galvanometer coils should be wound with the sized wire that will make its resistance equal to the joint resistance of the two branches in parallel with it, the battery branch being supposed to have been removed.

The values of y and z may be obtained in a similar manner to that of x, thus :

$$y = \frac{\begin{vmatrix} \overline{A+B+G} & 0 & -B \\ -G & 0 & -C \\ -B & e & \overline{B+C+F} \end{vmatrix}}{\Delta} = \frac{e\begin{vmatrix} -B & A+B+G \\ -C & -G \end{vmatrix}}{\Delta}$$

$$= \frac{e\{G(B+C) + C(A+B)\}}{\Delta}$$

$$z = \frac{\begin{vmatrix} \overline{A+B+G} & \overline{A+B} & 0 \\ -G & \overline{C+D} & 0 \\ -B & -\overline{(B+C)} & e \end{vmatrix}}{\Delta} = \frac{e\begin{vmatrix} \overline{A+B+G} & \overline{A+B} \\ -G & \overline{C+D} \end{vmatrix}}{\Delta}$$

$$= \frac{e\{G(A+B+C+D) + (A+B)(C+D)\}}{\Delta}.$$

The actual currents in the branches A, B, C, and D are :

Current in $A = x + y = \frac{e\{G(B+C) + B(C+D)\}}{\Delta}$.

Current in $B = z - (x+y) = \frac{e\{G(A+D) + A(C+D)\}}{\Delta}$.

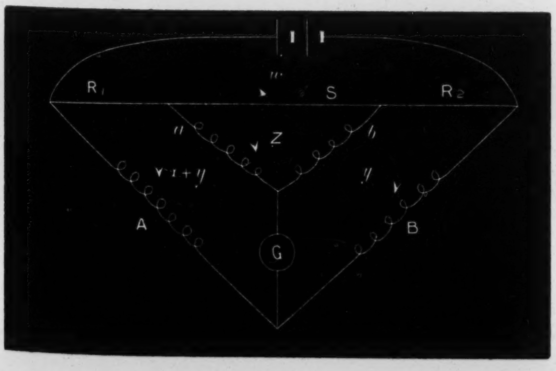
Current in $C = z - y = \frac{e\{G(A+D) + D(A+B)\}}{\Delta}$.

Current in $D = y = \frac{e\{G(B+C) + C(A+B)\}}{\Delta}$.

Note that since the circuit is symmetrical the currents in the branches B, C, and D may be obtained from the expression for the current in A by interchanging the letters : thus the current in B can be obtained by interchanging the letters A and B, and C and D in the expression $\frac{e\{G(B+C) + B(C+D)\}}{\Delta}$; this, as can be easily seen, makes no difference in the value of Δ.

Employment of Maxwell's cyclic symbols in deducing the conditions for working Thomson's double bridge.

R_1 and R_2 represent the two low resistances which are to be compared, A, B, a and b the four auxiliary resistances, S the resistance between R_1 and R_2.



We have the equations

$$(A + a + G)(x + y) - G\,y - a\,z - R_1 w = 0$$
$$(B + b + G)\,y - G(x + y) - b\,z - R_2 w = 0$$
$$(a + b + S)\,z - a(x + y) - b\,y - S\,w = 0$$

Rearranging

$$(A + a + G)\,x + (A + a)\,y - a\,z = R_1 w$$
$$- G\,x + (B + b)\,y - b\,z = R_2 w$$
$$- a\,x - (a + b)\,y + (a + b + S)\,z = S\,w$$

Hence

$$x = \frac{\begin{vmatrix} R_1 w & \overline{A+a} & -a \\ R_2 w & \overline{B+b} & -b \\ S\,w & -\overline{(a+b)} & \overline{a+b+S} \end{vmatrix}}{\Delta} = \frac{w\begin{vmatrix} R_1 & A & -a \\ R_2 & B & -b \\ S & S & \overline{a+b+S} \end{vmatrix}}{\Delta}$$

where Δ is the determinant whose columns are the coefficients of x, y, and z respectively.

$$x = \frac{w}{\Delta}\,[R_1\{B(a+b+S) + b\,S\} - R_2\{a\,S + A(a+b+S)\}$$
$$+ S(a\,B - A\,b)]$$

$$= \frac{w}{\Delta}\,[(a+b)(B\,R_1 - A\,R_2) + S\{(B\,R_1 - A\,R_2)$$
$$+ (b\,R_1 - a\,R_2) + (a\,B - A\,b)\}]$$

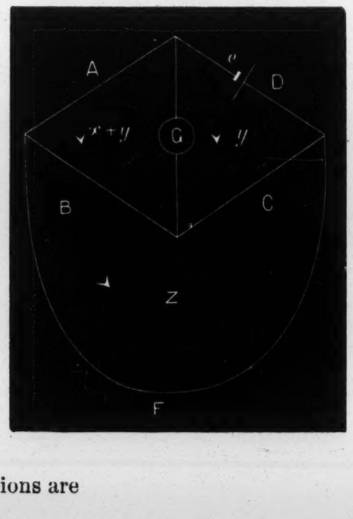
When there is a balance $x = 0$, and as Δ is finite since none of its constituents are infinite :

$$(a+b)(B\,R_1 - A\,R_2) + S\{(B\,R_1 - A\,R_2) + (b\,R_1 - a\,R_2)$$
$$+ (a\,B - A\,b)\} = 0.$$

If $S = 0$, this equation is satisfied when $B\,R_1 = A\,R_2$, but if S is not zero and is unknown, it is necessary that its coefficient should vanish, which will happen if $a\,B = A\,b$, in addition to the condition just obtained : that is $\frac{A}{B} = \frac{a}{b} = \frac{R_1}{R^2}$.

Mance's Battery Test.

In making this test the resistance of C is adjusted until the current through the galvanometer is the same, whatever the resistance of the conductor, F.



The equations are

$$(A + B + G)\,x + (A + B)\,y - B\,z = 0 \quad (1)$$
$$- G\,x + (C + D)\,y - C\,z = -e \quad (2)$$
$$- B\,x - (B + C)\,y + (B + C + F)\,z = 0 \quad (3)$$

$$x = \frac{\begin{vmatrix} 0 & \overline{A+B} & -B \\ -e & \overline{C+D} & -C \\ 0 & \overline{-(B+C)} & \overline{B+C+F} \end{vmatrix}}{\begin{vmatrix} \overline{A+B+G} & A+B & -B \\ -G & \overline{C+D} & -C \\ -B & \overline{-(B+C)} & \overline{B+C+F} \end{vmatrix}}$$

$$= \frac{-e \begin{vmatrix} \overline{-(B+C)} & \overline{B+C+F} \\ \overline{A+B} & -B \end{vmatrix}}{\Delta}$$

$$= \frac{e\,\{F(A+B) + A(B+C)\}}{\Delta}$$

To evaluate Δ, add column three to column one for a new first column; obtain a new second column in the same manner; then

$$\Delta = \begin{vmatrix} \overline{A+G} & A & -B \\ \overline{-(C+G)} & D & -C \\ \overline{C+F} & F & \overline{B+C+F} \end{vmatrix}$$

$$= \begin{vmatrix} \overline{C+F} & \overline{A+G} & \overline{-(C+G)} \\ F & A & D \\ \overline{B+C+F} & -B & -C \end{vmatrix}$$

$$= (C+F)(BD-AC) + F\{B(C+G) + C(A+G)\}$$
$$+ (B+C+F)\{D(A+G) + A(C+G)\}$$
$$= (C+F)(BD-AC) + (C+G)\{F(A+B) + A(B+C)\}$$
$$+ (A+G)\{F(C+D) + D(B+C)\}$$

Hence

$$x = \frac{e}{\dfrac{(C+F)(BD-AC)}{F(A+B)+A(B+C)} + C + G + (A+G)\dfrac{F(C+D)+D(B+C)}{F(A+B)+A(B+C)}}$$

Now, as x is to be independent of the value of F, the latter symbol must vanish from the denominator; this is obviously the case when $BD = AC$, as then $F(A+B) + A(B+C)$ becomes equal to $\frac{B}{C}\{F(C+D) + D(B+C)\}$, and hence

$$x = \frac{eB}{B(C+G) + C(A+G)};$$

a result independent of F.

False Zero Method.—Suppose an E.M.F., E, to be inserted in F. Equation (3) will become

$$-Bx - (B+C)y + (B+C+F)z = E$$

Hence

$$x = \frac{\begin{vmatrix} 0 & \overline{A+B} & -B \\ -e & \overline{C+D} & -C \\ E & \overline{-(B+C} & \overline{B+C+F} \end{vmatrix}}{\Delta}$$

$$= \frac{-e \begin{vmatrix} \overline{-(B+C)} & \overline{B+C+F} \\ \overline{A+B} & -B \end{vmatrix} + E \begin{vmatrix} \overline{A+B} & -B \\ \overline{C+D} & -C \end{vmatrix}}{\Delta}$$

$$= \frac{e\,\{F(A+B) + A(B+C)\}}{\Delta} + \frac{E(BD - AC)}{\Delta}$$

Now when $BD = AC$, the latter term vanishes, and the former one has just been shown to be independent of the value of F. Therefore x is independent of the values of both E and F; that is to say, the current through the galvanometer will be unaffected whatever values are given to the E.M.F. in branch F and to its resistance.

(*To be continued.*)

EICKEMEYER'S DYNAMO.

FOR Mr. Stephen D. Field's motor experiments on the Thirty-Fourth Street branch of the New York elevated railroad, the current was furnished by a dynamo designed and constructed by Mr. R. Eickemeyer, of Yonkers, N.Y. The illustrations in the present article show a machine of this type. It has been called an "iron-clad" dynamo, and an examination of the illustrations shows that it is in fact iron-clad throughout.

Fig. 1 shows the machine complete, and fig. 2 is a view of the same machine with one side of the iron covering removed.

It will be seen that the armature is enclosed in the field coils, and that its core is in reality the electro-magnet, the iron covering forming, as it were, the yoke pieces, completing the magnetic circuit. The field coils thus enclose the armature and are in turn enclosed by a rectangular iron frame, forming part of the magnetic circuit, and constituting the backbone of the machine. To furnish a proper support for the commutator end of the armature shaft the frame is extended beyond the field coils and encloses the commutator and brushes.

The field winding is composed of a number of coils separated by spaces to allow a free circulation of air; provision is also made to allow variations in the connections of the field coils for regulating purposes. A hand screw is provided by means of which the brushes, which are of the usual type, can be accurately adjusted.

Figs. 3 and 4 which represent cross-sections of the machine, show in detail the relative position of the armature, field coils, and the surrounding shell. This disposition of the field coils causes all the lines of force produced by the current in the field coils to pass through the armature core and to complete their circuit through the outer cast iron shell.

If this shell is of sufficient cross-section no lines of force appear on the outside, and all loss by leakage is prevented, and as the whole frame serves as a carrier of lines of force all the cast iron in the machine serves a useful purpose, not only as a frame but also as a part of the magnetic circuit.

While the machine thus differs radically from dynamo machines of the various types heretofore constructed in the disposition of the field wire, it also differs from them in the form and method of its armature winding.

The armature of the machine shown in figs. 1 and 2 has 44 coils of four windings each. These coils are wound upon a shaping frame, and when finished and thoroughly saturated with insulating material, are placed upon the cylindrical core, secured by the pins at the ends and bound around the circumference in the usual manner.

To cover the drum or core after the coils are made, or to remove the coils again, is the work of but a few hours. To wind the coils on the shaping frame is a very simple operation, and can be performed by ordinary workmen very rapidly.

Fig. 5 represents an armature covered with 44 coils of eight turns each, and fig. 6 shows one of these coils.

The advantage of this armature winding, aside from the facility with which the coils can be made and put in position on the drum are:—All the coils of the armature and every turn of every coil are absolutely of the same length. All the wires in each coil and all the coils on the armature are parallel to each other throughout their whole length.

The coils when wound are ready to be covered with insulating material, and can be tested thoroughly before they are put on the core. Should a defective coil be discovered after the armature has been completed, or should any coil become defective by accident, the coils can be readily taken off, the defective coil or coils replaced by perfect ones, and the whole put back on the armature again in less time than it would take to unwind an armature of the ordinary construction.

Another feature in favour of this mode of winding an armature is that the wires leading across the ends of the drum occupy less than half the space the same quantity of wire would occupy in the ordinary methods of winding armatures, and each coil lying parallel to the preceding one (throughout its length not a single wire crossing any other) the danger of burning out the armature is reduced to a minimum.

The above shown method of winding armature coils and inclosing the armature in the field coils is also applicable to machines having four or more poles, and this furnishes a means to produce an armature absolutely balanced mechanically as well as electrically.

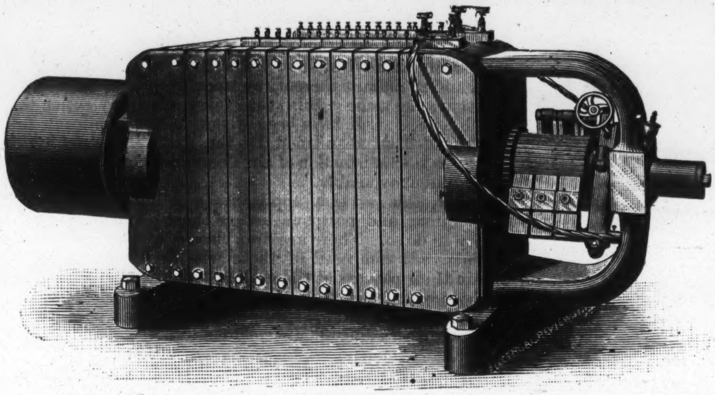


FIG. 1.

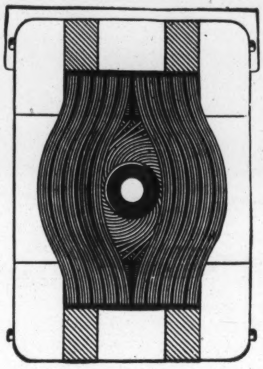


FIG. 3

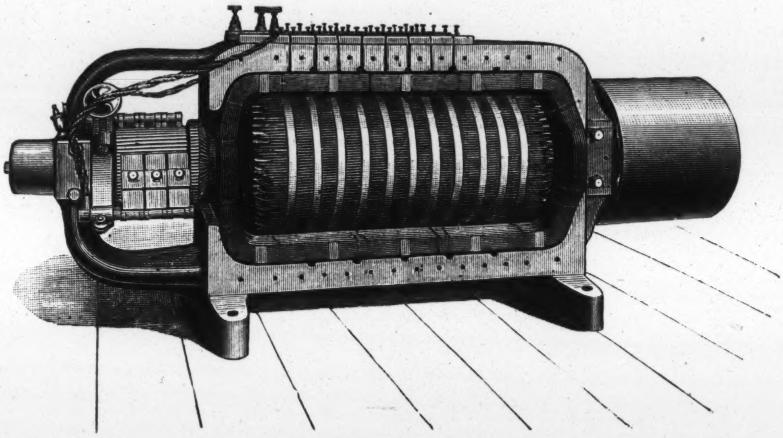


FIG. 2.

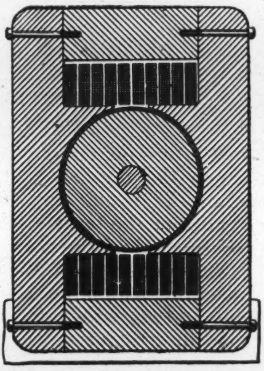


FIG. 4.

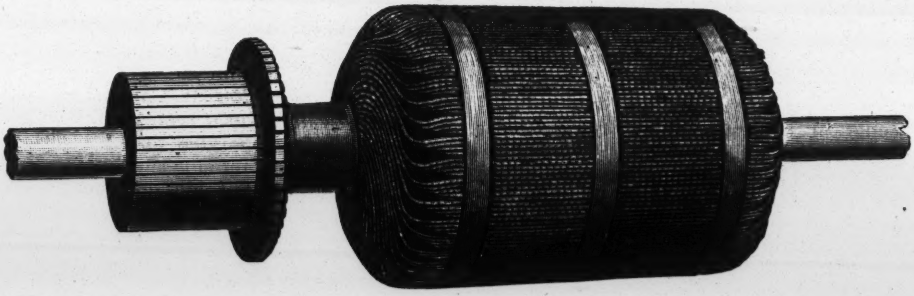


FIG. 5.

The tests made on machines of this type, indicate that the quantity of material required to produce a given out-put is less than two-thirds of that necessary in a machine of the ordinary form.

The machines being perfectly balanced mechanically, magnetically and electrically, there is no sparking at the brushes, and a change in the adjustment of the brushes is only required with extreme variations of the current taken off, and is even then very slight. The efficiency is as high as in the best machines constructed. From a mechanical point of view, it appears that all the parts are securely protected, and yet are easily accessible. The machine, as a whole, is compact and strong, and may be easily taken apart and remounted.

Mr. Eickemeyer, who has achieved a wide reputation as an inventor and manufacturer of machinery for the manufacturing of hats, an industry which he may be said to have revolutionised, furnished the *Electrical Engineer* of New York the following note on the steps that led him to develop and perfect his dynamo :—

"When Prof. Bell astonished the world with his telephone I became very much interested in that new wonder, and, like a good many others, I began to experiment.

"My experiments were on magneto-telephones, and the step to dynamos was a natural one. I made a great many dynamos of one type and another, steadily approaching the iron-clad form, and the machine as you know it is the result of experience gathered in their construction.

"The winding of the armature I found a troublesome piece of work, and I made many attempts to devise some method of simplifying the operation. Finally I perfected the winding as now made. The first large machine built was the one used to furnish the current for Mr. Stephen D. Field's motor, tried on the elevated railroad. Its performance far exceeded our expectations. The absence of sparking at the commutator showed that the machine was as well balanced electrically as could be desired, and, all in all, the machine seemed to be a step in the right direction.

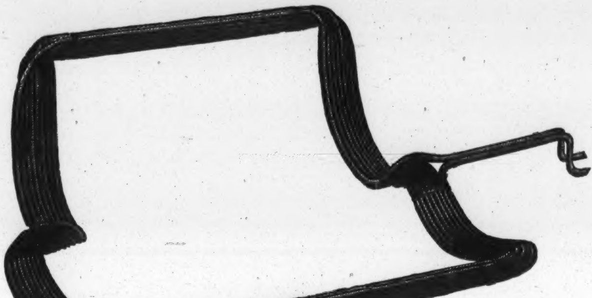


FIG. 6.

"My electrical experiments covered the space of a good many years, for they were only carried on at odd times, when they did not interfere with our regular business—the manufacture of hat machinery."

AMERICAN NOTES.

By DAS TELEPHON.

I HAVE heretofore on many occasions endeavoured to impress upon the minds of your intelligent readers some idea of the wonderful inventive genius of the genuine Yankee; the term Yankee must be applied to the sons of the soil of the New England States only.

John F. Chase, of Augusta, Maine, proposes to construct a flying machine which he has invented. It will be 20 feet long and six wide, and he expects to complete it in two or three months. Electricity or compressed air will be employed as motive power. When it is completed, Mr. Chase says he and another gentleman will enter it and fly to Washington, making the voyage (800 miles) in one day, and soaring above the clouds or skimming along just above the roofs as the operator chooses. He is positive that he can make 50 miles an hour, and, with a fair wind, 100.

Yankee-land seems to be ahead in reducing electric lighting to a minimum cost. Lewistown, Maine, owns its plant, and by the use of water power has reduced the cost to 14 cents per lamp per night, or $51.10 per year. The plant for 100 arc lights cost $14,500; the cost of construction was $450 per running mile. The price paid under contract was from 55 to 65 cents for lights burning only till midnight. At a cost of 14 cents each, the lights burn all night. Bay City, Mich., put in a plant in October, 1886, and supplied lights for $42 each per year, whereas it had been paying a private company $100 per year.

The possibility of the telegraph some day being a part of the postal system of the United States has at last been officially recognised by the Government. In the Act to authorise the construction of a railroad, waggon and foot passenger bridge across the Mississippi River, near Burlington, Iowa, approved by the President on January 31st, is a new provision of law. Heretofore all such Bills have made such proposed structures post routes, but this Act goes further, and says:—,'And the United States shall have the right of way for postal telegraph purposes across said bridge."

Inventors and patent attorneys may learn something to their advantage by carefully considering the following statements respecting a certain section of the patent laws of the United States, and also a late decision expounding the practice in the Patent Office rendered by the present Commissioner of Patents.

In the first place an inventor who has filed an application for a patent can secure "the absolute control and monopoly of the invention *indefinitely*" by delaying to complete his application—whereas he is secured for 17 years only if he completes his application and a patent is issued to him.

The following is quoted from the Report of the Commissioner of Patents for the year ending December 31st, 1887:—

> Section 4,894 provides—
>
> "All applications for patent shall be completed and prepared for examination within two years after the filing of the application, and in default thereof, or upon failure of the applicant to prosecute the same within two years after any action therein, of which notice shall have been given to the applicant, they shall be regarded as abandoned by the parties thereto, unless it be shown to the satisfaction of the Commissioner of Patents that such delay was unavoidable."
>
> Under this section applicants who desire to prolong their applications and postpone action therein have an ample opportunity to do so. There are two classes of persons who apply for patents, *one* composed of those who are exceedingly anxious to obtain their patents at the earliest practicable moment, the *other*, of those who desire to prolong the issue of their patents and to keep the application pending in the Patent Office to the very latest date possible. The second class embraces the more powerful, rich, and influential parties, who are either the inventors or the assignees of the inventors. This section of the statute enables the second class of persons to keep their applications pending in the office for years before their patents issue. In the mean time they are engaged in manufacturing and putting upon the market the article or improvement, but warning the public that the patent is applied for, the effect of which is to give them the absolute control and monopoly of the invention and to deter all other inventors from entering upon the same field of invention and from manufacturing the article. The manner in which this delay is effected may be briefly explained: The applicant files his application and is allowed two years within which to complete or perfect it. Any action of the office requiring change or modification or some formal correction can be followed under this section by a further delay of two years before the applicant is required to take any action in response. At the expiration of the two years he perhaps makes some amendment or change in the character of his claims. This involves a corresponding action on the part of the office, and, however prompt and speedy this action may be, the applicant is permitted another two years before any responsive action can be compelled from him; and so the matter may be continued. There are applications now in the office which have been kept alive nine or ten years, and the office is powerless to compel speedier or earlier action on the part of the applicants.

Amongst 507 applications under Division XVI., Electricity A., are included those of Berliner and Edison, for the exclusive use of carbon in a telephone transmitter, filed in 1877, the full history of which your readers will find in the REVIEW of November 18th, 1887.

I now invite special attention to a decision rendered by the Commissioner of Patents, full text of which is given below. This decision is totally at variance with the practice and rules of the Patent Office prior to the advent of the present Commissioner. I may say, parenthetically, that it seems to have been the practice of every new appointee to that position to endeavour to make a record for superior knowledge, either by reversing decisions of his predecessors or putting new constructions upon well-established patent laws and upon long established practice.

U.S. PATENT OFFICE.—TELEPHONES.

Petition.—Application filed February 7th, 1887, *No.* 226,851.

Applicant complains of the action of the examiner in refusing to call upon him and furnish him with an opportunity to demonstrate the operativeness of his invention.

This application was rejected by the examiner on January 26th, 1888, for lack of utility. On January 31st following applicant wrote the office insisting upon the operativeness of his invention. On February 10th, 1888, applicant, who had filed two affidavits in support of the operativeness of his invention, wrote the office calling attention to them, and requested their consideration. The examiner rejected the application a second time on February 11th, 1888, but in his official examination made no reference to the affidavits. Applicant complains of this, and requests that the examiner be required to give him an opportunity to demonstrate the operativeness of the invention by a working model and operating it before final rejection.

Applicant is under the impression that the examiner did not consider the affidavits of the electricians, Van der Weyde and Morton, because he does not make mention of them in his letter of final rejection. But this does not follow; they were part of the record, and Rule 75 gives applicant a right to present affidavits and have them considered before final rejection. The presumption is that they were so considered by the examiner. Even if they were not, they have their proper status in an appeal to the examiners-in-chief. I see no reason to interfere with the action of the examiner in this particular.

As to the right of applicant to file a model and demonstrate by experiments, &c., there is no rule of practice that requires this. The subject is wholly within the *discretion* of the examiner; he *may* require a model if he be of opinion that the case requires it: he *may* also allow an applicant to conduct experiments before him if he deem proper, or he *may* even witness the operation of the apparatus elsewhere and at other places, when circumstances render it impracticable for the experiments to be conducted in the office: but the subject is one that *depends* upon his *judgment* and *discretion* as to the necessity or propriety of such experiments. If the examiner is satisfied to act upon his *judgment* and *knowledge* as an *expert* without such experiment he is *free* to do so. There is *no rule* of which I am aware which would require him to accept working models, admit inventors and experts to pursue experiments and arguments, and compel him to *attend and witness them*. Nor am I aware *that such a practice has ever existed*.

The case having been twice rejected, I do not see that applicant has any remedy but to appeal. His petition is therefore denied.

BENTON J. HALL, *Commissioner*.

February 27th, 1888.

If this decision be correct, the examiner can reject an application for a patent if in *his judgment* the device is inoperative, and he has the power to refuse to the applicant "an opportunity to demonstrate the operativeness of his invention."

This decision, as will be seen, was rendered upon an appeal from a decision by Examiner Brown, who has within the past year been transferred from the examination of water-closet apparatus to that of electrical apparatus, and this individual is invested with the power of deciding upon the operativeness of electrical inventions—even those splendid ones of Sir William Thomson. What a farce! what a farce!!

My advice to all those who have applications now pending, or may hereafter apply for a patent in the United States, is to avail themselves of the Section 4,894, referred to by the Commissioner of Patents, and thereby raise the monopoly of their inventions *without* a patent for an unlimited number of years instead of submitting to the caprices of an examiner who knows as much about electricity as the inhabitants of the Sandwich Islands.

Washington, *March 9th*, 1888.

INSULATION AND INSTALLATION OF WIRES AND CONSTRUCTION OF PLANT.*

By Prof. ELIHU THOMSON, of Lynn, Mass.

I HAVE been requested to present my views on the above subject, and having recklessly allowed myself, in spite of the many other demands upon my time, to accept the chairmanship of your committee on the same subject, I have felt it my duty to at least say enough to provoke a general discussion and interchange of views between others who may have given more special study to matters in hand. My endeavour, therefore, will not be to arbitrarily lay down any rules, but rather to point out directions in which information may be gained and improvements made.

The subject is certainly very extensive in its scope, and could not be dealt with, except in a very superficial way, in the time at our command, and meanwhile I feel constrained to state that I make no claim to the possession of any of the qualifications which would be requisite for thorough work on the subject.

In the installation of an electric light or power plant we first of all find that the conditions vary very widely. Its size, location, the distance covered, or length of circuits and the climatic effect met with need to be considered. Then, again, the nature of the plant itself, whether arc light, direct incandescent, alternating system with transformers or converters, &c., governs to a large extent the conditions of the installation of the wires and of the plant itself. We may, of course, find in a single station or installation representations of these and other characters of plant, such as medium potential circuits for power transmission alone.

Three or four years ago we should have been required only to take into account simple cases of light potential for arc circuits and low potential direct currents for incandescent multiple arc circuits, but the range now covered may be considered to be from any potential above fifty (50) volts up to several thousands, and any current strength from about one ampère up to several thousands of ampères.

In considering the proper insulation and installing of wires for conveying these potentials and currents we are required to still further extend our field of view, and divide them into aerial or overhead wires or conductors and underground systems, and each of these, taken in connection with the conductors for indoor distribution to the lamps, motors, or other energy users. We have thus outlined the field which should be covered in dealing with a subject such as we have before us. "Insulation and installation of wires and construction of plant" would furnish us a subject material to fill a many-paged volume, and not by any means exhaust it. May such a work soon be forthcoming.

Concerning the relative merits of overhead conductors and underground conductors, it is pretty generally agreed that, except for expense and the difficulties of insulation and connections from the mains, the underground system would be preferable as avoiding unsightliness and liability of interference, either by leakage, inductions, or contact with other overhead wires. How to preserve the insulation of lines conveying high potentials, which potentials cannot be avoided if distance is to be covered, without conductors of such size as to have a prohibitive cost, is a vital question. It may well be conceded that when the potentials used are very low, say one hundred or two hundred volts, the difficulties of insulation are very slight as compared with those of the use of two or three thousand volts.

It is a notable fact that, so far as concerns the placing of overhead wires, particularly the wires of telegraph, telephone, and such systems, and in some cases of electric light wires, extreme disregard of system or orderly direction for such wires is the cause of much of the unsightly appearance presented by them, and much of the liability to get out of order. The tendency, also, has been to use very light and easily broken wires for telephonic work, such as may at any time come down upon the necessarily strong or electric light wires, strength being synonymous with efficiency in these latter.

It is thought that there is need of some rules or enactments which shall render impossible the mazes of telegraph, telephone, private wires, fire alarm, live wires, dead wires, and electric light wires (which for our purposes may be considered as very live wires), such as may be seen in many of our large cities.

Should the wires of all kinds be laid or hung in orderly bundles, having a definite direction and only changing that direction by definite angles, such as right angles, in accordance with a pre-arranged system, I think that much of the objection now existing to the placing of overhead conductors could be eliminated. Add to this a requirement increasing the durability and tenacity demanded for telephone and telegraph wires and their supports, and the dangers of leaks and grounds would in large measure be removed.

Many trials have been made, and considerable progress has resulted therefrom, in the direction of securing an insulating covering for electric wires, such as may adapt them to the use of high potentials without leakage, and prevent contacts forming by abrasion with other wires. This appears to be one of the most difficult problems in electric engineering. The problem is not so much to find a first class insulating substance for wire covering, but to find combined therewith, or to combine therewith, the qualities of indefinite durability when exposed to the weather, and great toughness and power of resisting cutting or abrasion. For overhead work, not only is an excellent insulator capable of withstanding very high potentials without leakage or rupture required, but such property must be retained along with the mechanical properties of hardness and toughness for indefinite periods. Besides, the cost must not be too great.

To what extent any specimen or quality of insulated wire, or insulating material for out-door use, fulfils these requirements is a matter which it is difficult indeed to determine fully, particularly as a test for durability must necessarily require a long time to complete. Indeed, it would seem that our best guide must be the experience gained in the use of different wires on a large scale, under different climatic conditions, and with extremes of heat and cold more or less great.

Aside from the insulation given to a wire by its covering considered purely as an insulator, most stress must be laid upon the requirement of resistance to mechanical friction or abrasion, as tending to give immunity from grounds by contact with other wires, or with tree branches, roofs, cornices, &c.

Toughness and elasticity of the insulation are hence seen to be qualities of high importance. Whether such mechanical tests as will represent the conditions of actual practice in the use of the wire in relation to abrasion and percussion, bending, &c., which may break through the coating of insulator, can be devised and applied to test wire is somewhat doubtful, though without doubt much information may be obtained in the pursuance of such an object.

The retention of the toughness and elasticity for reasonable periods is, of course, demanded, and it is this retention which in otherwise excellent coverings is often absent, the effect of exposure being to render the materials brittle and porous.

It has often been proposed to make tests of the insulation resistance of the coverings of certain lengths of any wire taken as samples representing an average for such wires under potential somewhat exceeding that existing under actual use or practice, and so to determine the insulating capabilities of different coverings, but it is my opinion that while such tests are certainly useful and important, and in the case of underground wires or cables indispensable; yet, for overhead work, since most of the length of the wire is exposed to air only, which is a practically perfect insulator, and since the chances of leakage from the lines arises most from imperfectly insulating supports and from accidental contact with other wires or surfaces, additional tests would, in any case, be required to determine suitability of an insulator for overhead lines. In this connection it may be stated that during thunderstorms overhead wires are subjected to violent inductional effects giving rise oftentimes to the momentary charging of the lines with potentials very far in excess of the potentials of any dynamos, and capable of breaking through the wire covering where it may be near, or touch a metal object or wet surface. This breaking through may give rise to a weak spot which will be followed by the dynamo current itself if of high potential, and if at the same time other conditions be favourable to a diverson of current. When overhead wires or pole lines are required to pass through and between branches of trees, a condition not infrequent in many of our towns and cities, considerable difficulty may be found in preserving the insulation of the line, the covering of which is apt to be rubbed off by the tree branches swaying in the wind. Fastening insulators to the branches for support and attachment of the wires is an uncertain remedy on account of the swaying of the tree taking place in different directions not transverse to the line of wire, so that the wire is strained or detached from its support along with the insulator by the violence of the actions.

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* Read at the meeting of the American National Electric Light Association, Pittsburgh, February 21st, 1888.

Many and ingenious are the devices which the over-zealous lineman makes use of to suddenly, or gradually and mysteriously lop off the offending limb, when the case is exceptionally critical and permission for the amputation of the offending limb cannot be obtained from the conservative citizen whose sidewalk supports the obstacle to linemen's ambition. It is also customary to thicken the insulation of the wire at such places as are threatened by abrasion, by winding on it a wide band of tough and plastic adhesive tape, such as can now be found in the market. If neatly and thoroughly done, the insulation of the wire may thus often be preserved under decidedly adverse conditions.

It must be admitted that the insulation of a high potential circuit can never be too good, and that therefore any measure which may tend to its improvement and preservation is a double advantage, for not only are the dangers of grounds and leaks lessened, but the power of the current to do useful work is assisted.

A considerable leakage from a high potential circuit means indeed a loss of power or efficiency of the system; for instance, the loss of one half an ampère of current at a potential of fifteen hundred (1,500) volts would represent about one horse-power of current energy lost, costing more than a horse-power at the dynamo pulley to supply such a leak. This latter consideration is of special importance in dealing with lines feeding transformers with alternative currents at high potentials. With one thousand (1,000) volts in the primary circuit, it is readily seen that a badly constructed or leaky line might easily cause the loss of a considerable percentage of current, such as would reduce the economy of the system more, particularly when running under light loads, at which time it is desirable to secure and to keep up the best possible efficiency.

If the wires or cables are to be laid underground, their resistance to abrasion is of importance only when they require to be drawn into conduits, or sections of conduits; but when once placed intact they are not necessarily further subject to mechanical injury, as they are generally surrounded by protective castings or tubes.

The total exclusion of moisture and the possession by the wire coverings of a high insulation resistance, are requisites of great importance in such work. The difficulties are with low potentials comparatively easy to provide against, but in the case of wires at high electric potentials or pressures, such as arc light or alternating current primary lines, such difficulties are much exaggerated.

The least excess of moisture, such as may occur by flaws in the insulation, may result in the production of a bad ground or slight leak due to some original defect, may so improve itself by the passage of a current as to become a bad flaw or a complete connection to earth. It would seem best in all cases not to place reliance upon the integrity and perfection of but a single insulating coating or covering for the wire, but to give to it, say, three coatings successively applied, and which are in a measure independent coverings, all of them impervious to moisture and good insulators. If composed of different materials the peculiar liabilities to defect of one such coating may possibly be compensated by other qualities in another coating, so that there may be small chance of superposed defect in all coatings alike.

Let but the insulating capacity of each layer or coating be amply good to withstand the potential used, and it is difficult to conceive how trouble could arise from leaks due to defective portions of the covering. First cost is, however, a barrier to the perfection of underground systems; to save which cost less effective and cheap structures are often given the place which should be occupied by the more perfect and more costly.

It is important that in cases in which overhead wires or wires above ground are connected with underground lines, efficient means for carrying inductive discharges to earth be provided, such as is secured by the use of proper lightning arresters, for faults may otherwise be produced in the best underground system of conductors due to static inductional discharges existing during thunderstorms at the movements of lightning discharge. These discharges are, in overhead lines, oftentimes quite vigorous and capable of puncturing moderate thicknesses of insulation. They are not to be confounded with actual passages of lightning strokes to the lines, which, of course, have an infinitely greater capacity for mischief.

The preservation of the insulation of inside wiring is not difficult where the potentials used are low, nor is it difficult, with due exercise of care and skill in the running of the wires and the selection of suitable courses for them to take, to instal simple series of lines, such as those for arc lights, which shall be practically exempt from leakage, unless abraded and brought into contact with conducting objects or moist surfaces involving leak to earth. Unfortunately, owing to lack of skill and judgment and haste in installing, much of the wiring done is not as well done as it should be for the best results.

Distribution of current to groups of incandescent lights upon arc light or other high potential lines should always be undertaken with great care, and it is thought that such work should only be undertaken when exceptionally favourable conditions for avoiding accidental leakages exist; more especially should the potential of the line at the dynamo exceed fifteen hundred (1,500) volts, or an amount which would sustain 30 arc lamps in series. One of the important elements of safety in such installations is simplicity and ease of inspection of the wiring, and no concealed wire should be used in them.

Concerning the wires which are suitable for indoor work, and particularly for high potentials, the endeavour has been to combine moisture proof and fire resisting, or rather incombustible, materials in the covering. The difficulty has been to find moisture-resisting substances which would not carry fire, and fire-resisting or incombustible material which would not carry or absorb moisture. The two properties seem in most cases incompatibles. The tendency now is to surround the wire with a first covering of moisture-proof material of the nature of rubber, bitumen, resins, &c., and outside of this to place a second layer, which layer will not carry fire. For house-to-house and general incandescent lighting, where the distances from the station are not too great, the direct low potential systems possess most of the advantages, the difficulties of leakage from defective insulation being, of course, at a minimum; but where the distances are so great as to make the required outlay for copper in the conductors practically prohibit the extension of the system, a transformer or converter system, if of good design and economy, may be made to yield excellent results. In such cases, the high potential primary wires need not enter the building, or when they do may be suitably protected, the house or inside lines being of such low potentials as to be run with ordinary precautions as to leakage. However, the integrity of the system would be changed should a connection or leak form between the primary and secondary wires of the transformer, thus connecting the local or house line with the high potential outside mains. Such a connection might easily exist unsuspected, and would be a constant source of menace or possible danger, not discoverable by the mere tests for grounds as applied to the primary line at the station. The expedient of securely grounding the secondary or local line was devised by me to overcome this difficulty. It insures immunity from the risks arising out of possible leaks from the primary lines to the house lines, because such leaks are at once detected by the ordinary tests for grounds.

The consideration of the subject of what appliances are the best for the detection and location of leaks or faults in the insertion of conductors when they exist, and whether the ordinary crude methods are adapted to all cases of such detection, would prolong the present paper much beyond its intended limits, and it will have served its object if it opens up an opportunity or gives occasion for a pre-discussion and interchange of experience and ideas upon the general subject forming its title.

DISCUSSION.

MR. LEGGETT: I wish to make simply a suggestion which occurred to me as this paper was read. It is doubtless a suggestion which has arisen in the minds of members of this committee, but it is barely possible that it may not have. That is the effect upon a lead-covered cable, of a short kink in the cable, or of a dent in the lead—the compressson of the insulation whereby the insulation is rendered a better conductor, and so at that point there is a better opportunity for the current to leak out. I suppose that has occurred again and again to members of the committee. In the matter of insulation it seems to me that would be a good point to consider. The same, of course, should be considered in respect to other insulations beside the lead covering. There is one other point that occurred to my mind in the reading of the report that possibly might properly come under the consideration of some other paper. I notice Prof. Thomson refers to the high potential of the alternating current—whether that matter has been considered as to whether it is as high a potential as is reckoned—as 1,000 volts—whether or not the alternation of the current, whereby at one instant there is no current, at the next instant a current in one direction, and the next instant no current, and then a current in the opposite direction—whether or not the potential, instead of being 1,000 volts, is not 500 volts—I do not refer to the potential, I refer more particularly to the action of the insulation—whether or not the conductivity of the insulation is not required to carry a current of 500 volts rather than 1,000—whether it is not an average between no current and full current, and whether that does not account for the fact, which I understand to be a fact, that with the Westinghouse alternating current they have put underground a number of their lead covered conductors with good results—whether the result is not due to the fact that there is less required of the insulation.

Mr. Rice: If I am allowed to answer Dr. Leggett on that point I would say it is just about the other way. The potential that the insulator has to stand on a thousand volt alternating circuit is two thousand volts, just about double what would be on a direct current. That is occasioned by the wave going up for two thousand volts and then going down to zero. When you say two thousand volts it means an average of one thousand volts, and for a certain period of time that has to go to two thousand volts, making an average of one thousand. Perhaps the reason we do not have any more current with the alternating current than the direct is that there is no active kick to speak of on a disruption of the line; whereas with a direct current there is quite a kick.

Dr. Moses: I am glad that Mr. Rice has spoken on the question of the excess of potential above the general average, and also that Mr. Leggett has called attention to the fact. It is a mere hypothesis that the potential rises to two thousand volts, because in measuring those currents Prof. Rice will bear me out that he has never seen indications with an alternating current of a thousand volts potential. It therefore simply becomes a hypothesis. Because the current goes to zero and rises from zero it is supposed that the average must be one thousand, and that the extremes should be zero and one thousand. But there is no evidence in that fact whatever. It is a surmise, and it would be a very important thing for this committee to bear that in mind, and the secretary in making notes of these things would oblige us by sending to the chairman of the committee these points, so that they may be worked up. They are very important to be known. I myself am pleased to hear that suggestion of Mr. Leggett, that the condensation of a lead-covered cable may act somewhat in the light of points in static discharge.

Mr. Leggett: My point on that went a little further—the compression of the insulation itself. For instance, carbon chips will form a very excellent resistance for the passage of the electric current, yet if you compress those carbon chips they become a good conductor. The question is whether the compression of the insulation by the kink in the wire, or by the bend in the wire, does not serve at that point to make the insulation a better conductor.

Dr. Moses: I would say that perhaps the compression at that point will be extended as a pressure in the liquid, because these insulating materials are expanded and extended uniformly throughout the mass in the neighbourhood of the compressed point; so that the pressure will be distributed very evenly throughout. In the telephone, for instance, when the carbon button is compressed, it is not impossible that the compression extends throughout the whole mass, and the multiplicity of points brought into varying contact produces the effects stated; so that the compression may thus extend through the whole mass. I think unless there is an induction taking place, each reversal of the current, that I first suggested, that the point of pressure might be the one most dangerous, and the one which should be very carefully looked after.

Mr. Eustis: With regard to underground wires, I wish to mention a little result that came to my notice some time since, which may be of some use to the convention. In Prof. Thomson's paper he states that after the cables are once laid they are then not liable to be disturbed, owing to the mechanical covering outside. But I know of one particular case in which the insulating wires were laid in a conduit by a railroad track in a box about 6 inches square. Three or four wires were laid in that loosely. Every time it rained the water from the side of the tracks washed more or less through this conduit, and carried with it, I presume, some sand. At all events, after the wires had been laid there about two years the insulation was found to be destroyed, and on drawing the cables out it was found to be due almost entirely, as far as outside appearance went, to the purely mechanical injury. The only explanation that I can see for that was the fact that as the heavy trains went over this conduit they compressed the ground, and the cables being laid, as it were, suspended, owing to its own stiffness, the two wires slipped by each other and gradually chafed the face of the two wires, one upon the other, and cut the insulation through. If any one has had a similar experience I think it would be a benefit to the association if he would state it.

Dr. Moses: I would like to ask if those wires were suspended or laid on the board.

Mr. Eustis: They were simply laid loose.

Dr. Moses: Not only holding their own weight?

Mr. Eustis: They were thrown into this box loosely, and they were undoubtedly full of kinks. My idea is that, as the box gave from the weight of the trains, the wire being loose in the box, because of its own stiffness, would spring against one another, the two wires bending differently.

Dr. Moses: I would like to mention in connection with that, some curious facts that came to my attention yesterday, and which were told to me while several members of the committee were being hospitably entertained by the gentlemen here. We were visiting the Westinghouse works, and saw a very large trip hammer, and when we were up in the cosy office we could hear that rebounding and shaking the foundations with a force that was quite terrific. One of the gentlemen cited a fact, and a very interesting one it is, to show how, under repeated blows, material may be projected through a mass of other material. These slight vibrations might very easily cause the abrasion of the outer covering of two wires, if, when the trip hammer falls upon an anvil, an iron scale gets between that and the anvil, the iron scale can be forced through the body of the anvil and come out at the lower side, as is said to be the experience of many iron workers in Pittsburgh. It is a very interesting fact. I knew that, if a ball be put upon a solid barrel of resin, it will, after a while, be found at the bottom—its weight acting upon the viscous mass, causing it gradually to descend to it. And, as for instance, the impression of certain strong intellects may be felt over very large bodies of men, by persistent action—as I know occurred in one very particular case that I will not cite. But that is a very interesting fact. It also recalls to my mind a fact, which I had the pleasure of stating at the last meeting of the Association that, among the cables of the Brooklyn Bridge, there are some hard-drawn wires that are always being thought of by the constructors of that bridge, because they are afraid that with the gradual stretching of the cable those hard-drawn wires will be less effective than the softer ones, and ultimately, so great a strain will come upon them, that they will be ruptured. So that the very small action, long continued, may produce just the results that he speaks of.

Mr. Eustis: With regard to the matter of the scale going through the anvil, I will say that in this particular case the abrasion takes place for lengths of about 6 inches, or 12 inches, at different places throughout the whole length of the wire, and extending a distance of something like 50 feet. There would be places 8 inches in length, where the outside covering was completely chafed through, evidently from some change of that kind. What it is caused by we do not know. In other places the insulation was perfectly intact.

Mr. Brooks: This slight jar or concussion can only be seen after a time. This matter was brought to my notice the other day by the Pennsylvania Railroad Company. They had laid three cables in a wooden box along their railroad track. The boxes are 4 inches square, and fastened or closed; but it was found after a while that the cables began to give way. They opened the boxes, and they found that where they were laid on the bottom board of the box the cables had worked, by reason of this jar, about half way through the board, and it had taken the covering off, greatly to their surprise, so that the insulation was interrupted. I have heard that in London, where they run the pipes on the overhead ways, even on those made of bricks or of solid masonry this continued jar will in time begin to affect them, so that it is well when anything of that kind is laid to have it away from anything like concussion, although the concussion may be but small in amount.

Mr. Sperry: Inasmuch as we have Mr. Sunny with us, and he has a large experience in handling high potential direct currents underground, and as this matter of insulation is a very important matter, and anybody who can give us light upon it should be heard, I would suggest that he give us the benefit of his experience.

Mr. Sunny: My connection with the electric light business has only been for a short period; and I do not know that I am very much acquainted with it to speak on the subject. We have had some experience with underground cables, and I have made some memoranda indicating the results of our experience which I intend to present when the discussion of underground cables come up, as I understand it will in a day or two. I would like to state, however, in reply to Mr. Leggett's question as to the effect of a dent in a lead cable, what the effects are upon insulation. We have today a large number of burn-outs in our lead-covered cables; and I have been investigating a few of them, and I find as a rule the cable has burned out at a point where the surface was perfectly true, and where there were no indications of mechanical injury. On the other hand, in pulling out cables which have been destroyed, we have found portions of them where the mechanical injuries have been so great as to completely clean the lead off the insulation, leaving the lead bared. There was no indication, at the point where the lead was bared off, that any leak of the current occurred at that point. The facts that I have embodied in this short report are at the pleasure of the convention.

Mr. Leggett: I would like to inquire, in those cases where a leak occurs, whether that leak is apt to occur at a point where the wire crosses above, or in the vicinity of steam pipes, or any other hot pipes, is one which would be caused simply by a difference in the expansion of the copper and lead, whereby one wire would be caused to force itself against the other, or compress the insulation between itself and the other.

THE ELECTROLYSIS OF COPPER SULPHATE IN STANDARDISING ELECTRICAL INSTRUMENTS.*

Owing to the great increase in the use of electricity in recent years, and the consequent importance of having accurate measuring instruments, it is necessary that electricians should have some accurate means whereby they may have their standard instruments readily and cheaply checked from time to time. Much might be said for a national recognition of this fact by the establishment of a system of electrical standards, just as we now have national standards of length, weight, &c., but such a subject is beyond the province of this paper, in which I propose to give a description of an application of the electrolysis of copper sulphate, which has been employed, for standardising purposes, in the Physical Laboratory of Glasgow University for the last two years with the most satisfactory results.

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* Paper read before the Physical Society of Glasgow University, January 27th, by Mr. A. W. Meikle, Thomson experimental scholar.

A paper communicated by Mr. Thomas Gray to the *Philosophical Magazine* for November, 1886, dealt with the question of the reliableness of copper electrolysis as compared with silver. The conclusion drawn from the investigation described in that paper was, that while silver in the hands of a trained experimenter left nothing to be desired in point of accuracy, still it is open to the objections that it is very costly where large currents are used, and requires great care in making the experiments. Copper, on the other hand, has the advantage of simplicity in manipulation, and where attention is given to a few necessary precautions, great accuracy can be obtained. As an example of the difficulties in the use of silver, I may mention that the deposit, which is always crystalline in form, requires careful handling in order to prevent loss in drying or weighing; and, in order to get it thoroughly adherent to the plate, the area of the cathode or gain plate should never be less than 200, or more than 400 square cms. per ampère. With copper, the deposit for areas exceeding 20 square cms. per ampère is thoroughly adherent to the plate, of which, indeed, it forms an integral part. Thus in making an electrolysis of copper sulphate for 100 ampères, a current density of 1 ampère to 50 square cms. would give excellent results, and the total area of gain plates would only be 5,000 square cms., while were silver used, the area would require to be from 20,000 to 30,000 square cms.

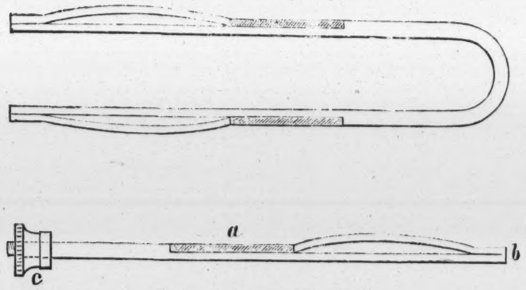
One disadvantage which copper has is its readiness to oxidise when exposed to the air, more especially when being taken out of the sulphate of copper solution; but if the mode of cleaning and drying the plates, both before and after electrolytic action, which is described in this paper be employed, this difficulty is easily overcome. I have kept plates for a week after being treated in this manner without being able to observe any change of weight as indicated by a chemical balance, which is sensitive to $\frac{1}{10000}$ of a gramme.

Another point, which has to be taken into account, is the fact that the plates lose weight in the solution at a rate varying with the area they expose to the action of the acid which is contained in all electrolytic solutions of sulphate of copper capable of giving reliable results. This question was gone into very fully by Mr. Gray about two years ago, and the results are given in his paper on electrolysis which is referred to above. It has again been gone into when making some experiments on the effect of temperature on the loss of weight of the plates in the solution. The results of these experiments, which were made by passing the current through 10 cells in series, each of which had a different area of plate, is to confirm the experiments made by Mr. Gray, and to show that the amount of variation from the true electro-chemical equivalent of copper due to differences of current density can be allowed for with great accuracy. Before describing particularly the results of these experiments, it may be well to refer briefly to the apparatus used.

Electrolytic Cells.

The electrolytic cell found most convenient for small currents consists of a round glass jar nearly filled with sulphate of copper solution, into which three vertical plates with their surfaces parallel and about 15 mm. apart are held by means of rigid platinoid clips. The two outside clips are joined together, and the plates held in them are the anodes or loss plates (see fig. 1).

Clips for holding Loss Plates.



Clips for holding Gain Plate.

FIG. 1.

Two loss plates are always put into each cell, one on each side of the gain plate, so that the gain plate may receive a uniform deposit on each side. The centre clip, which is well insulated from the two others, holds the cathode or gain plate. The clips for holding the gain plates are formed of straight pieces of No. 6 platinoid wire about 6 inches long, a portion of which, about 4 inches long, is filed flat, and on to this another piece of platinoid, bent so as to form a powerful spring, is soldered at *a*, so that the two ends of the pieces form a firm contact at *b* (fig. 1). A binding screw for fixing on the electrode is screwed on to the other end at *c*. Several of the clips so formed are firmly clamped on to a rectangular wooden frame by screwing a strip of wood down on the top of them, the portion of the clip between the wood being well insulated by being covered by a piece of thick India-rubber tube.

The clips for holding the loss plates are formed in the same manner as the gain plates, but are made in pairs by bending a piece of No. 6 platinoid wire into the shape of a U, with about 3 centimetres between its ends, and then soldering on the springs as already described. These clips are insulated and fixed on to the frame on the opposite side from the single clips, so that the ends of the latter come just between the two ends of the former, as shown in fig. 2. A flexible-covered copper wire, of convenient length to enable the cells to be joined in series if desired, is permanently soldered on to the bend of the double clips. This mode of placing several sets of clips on a wooden stand is found very convenient, as the plates can readily be adjusted in their position, or taken out, without disturbing any of the other arrangements. This form of clip suits very well for currents up to about 15 ampères, by joining the cells in series or parallel, as may be necessary. In using electrolysis for small currents up to 2 ampères, it is advisable to use two or even three cells in series, as with small deposits a check is thus obtained on the weighing or any defect in an individual cell. With currents of from 3 to 15 ampères, I prefer still to use this form of clip and a sufficient number of cells in parallel, each having gain plates of about 130 square cms. in area, so that the plates, owing to their comparative lightness, may be weighed on the chemical balance—the additional number of weighings being more than compensated for by the additional accuracy obtained.

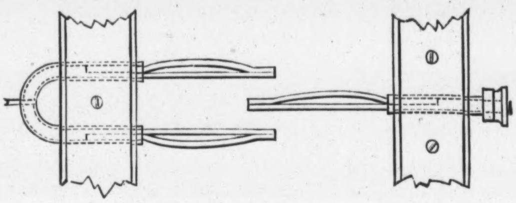


FIG. 2.

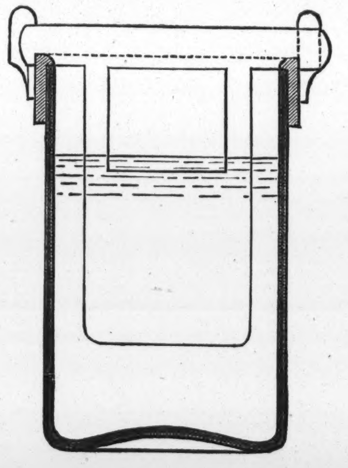


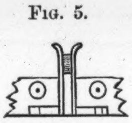
FIG. 3.

For currents such as are used in standardising a deca or hecto-ampère balance, owing to the large amount of copper deposited, such delicate weighing is not necessary, and a balance sensitive to about 2 milligrammes may be used; but even were an error of 5 milligrammes made in weighing the plates of an electrolysis for 50 ampères continued for one hour the error would only amount to about $\frac{1}{120}$th per cent. For high currents, such as these, a large earthenware cell is used, which is shown in figs. 3 and 4. A wooden frame is fitted on to the top of this cell, and on two opposite sides of this frame, and well insulated from each other, two copper bars are screwed, one having 10 and the other 11 spring contact clips of the form shown in fig. 5. The plates for this cell are made of sheets of copper, each of which has a rigid strip of copper soldered to its top edge and projecting about two inches on each side of the plate. On putting the plates into the cell, one end of this strip fits into a clip and the other rests in a vulcanite notch on the other side of the cell. Each of the plates when in position exposes a surface of 1,100 sq. cms. to electrolytic action, so by putting in the proper number of plates the cell can be used for currents up to 200 ampères. The plates and clips are so arranged that one gain plate comes between two loss plates, and the latter always exceed the former in number by one. As the plates, when all are put in, are very close together two glass tubes bent so as to form U's and long enough to reach to the bottom of the cell are hung over each loss plate to prevent any danger of the plates touching. Two flexible electrodes suitable for dipping into mercury cups are attached to the bars carrying the clips.

The Solution for the Electrolytic Cells.

The solution used is made by dissolving commercial copper sulphate in pure water as it comes from the Glasgow Corporation's water pipes until a density of from 1·15 to 1·18 is obtained, and then adding 1 per cent. of free sulphuric acid. In all the experiments mentioned in this paper the solution used has been of a uniform density of 1·175, but it has been found that a variation in density from 1·1 to 2 makes no difference in the nature or quantity of the deposit. With solutions made up as described perfectly accordant results have invariably been obtained. The solution should not be used too often as the acid is after a time exhausted by action with the plates, and it has been found from experience that unless the solution is decidedly acid the plates are oxidised in the solution and very irregular results are obtained which are quite valueless for accurate standardising. The table of curves (No. I.) shows very clearly the difference between results obtained from solutions which have free acid, and those which have not. The five curves are taken from experiments made with 10 cells in series and different areas of gain plate in each. The abscissæ are areas of gain plates in square centimetres per ampère, and the ordinates are deposits in grammes. It will at once be observed that the curves I., II., and III. are exactly similar in form. Curve I. is the mean of about 12 experiments made with free acid in the solution. Curves II. and III. are from two single experiments, also with about 1 per cent. of free acid in the solution. Curve IV. is taken from an experiment made with solution which had been used too often, and the results are irregular owing to oxidation of the plates in the solution. Curve V. shows the results obtained from a solution in which some copper oxide had been dissolved so as to withdraw all the free acid. The gain plates were found to be very much oxidised when taken out of the solution and had a dark brown colour instead of the bright metallic surface which they have when taken from a solution which contains acid.

FIG. 5.



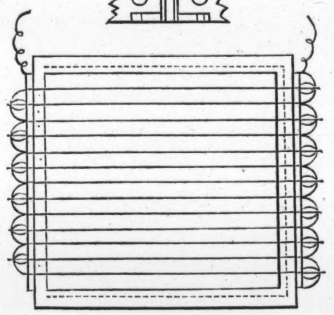


FIG. 4.

Preparation of Plates.

The gain plates used are made from ordinary high conductivity sheet copper about $\frac{3}{10}$ths of a millimetre in thickness. For the smaller cells they are cut in the shape shown in fig. 6, as this form of plate, owing to the flexible tongue, is very easy to adjust in its position, and when in use the whole plate is immersed in the solution, except the narrow tongue necessary to hold the plate between the contact clips, thus leaving a very small area exposed to any possible oxidation by the atmosphere. This form of plate has also the advantage that the area exposed to electrolytic action can be got at once, or may be permanently stamped upon the tongue, and the proper equivalent for the current density can be taken without having to measure the area covered by the deposit. The edges of the plate are all smoothed, and the corners rounded off, as the deposit is apt to form on any rough edges, especially if a high current density is being used, or if the current is being run for a long time. When this has taken place the plates, owing to the roughness of the surface, are not so readily dried, and the risk of oxidation is increased, as is also the risk of losing part of the deposit should the plate accidentally strike against any object. The surface of the plate is burnished with fine glass paper until perfectly bright and smooth, then rubbed with a piece of clean cloth, and finally wiped gently with a piece of silk to remove any shreds, after which they are ready for weighing. Another plan, which has been successfully employed, is to polish the plate with silver sand and water to which a few drops of sulphuric acid was sometimes added. The plates are then washed in clean water to remove the sand, and placed in a vessel containing pure water with a little sulphuric acid in it to remove any oxide which may have formed during the washing. From this they are taken one at a time, quickly dipped in fresh water, and dried immediately on clean white blotting paper, then held before a fire to remove any trace of moisture which might remain. The method which has been found most convenient, however, is to place a sheet of No. 1 glass paper on a wooden roller and spin it in a turning lathe, holding the plate against it by a pad. When the plates have been burnished by this method, the sand paper, which is only held on the roller by two springs, is removed, and a piece of rough cloth put on instead. On this cloth the plates receive a final polish to remove grains of sand, then wiped with a piece of silk, as in the first method, after which they are ready for weighing. Care should be taken never to touch the portion of the plate intended for immersion in the cell with the fingers, as by so doing the surface is spoiled for a deposit and the mark of the finger is seen distinctly after the electrolytic action.

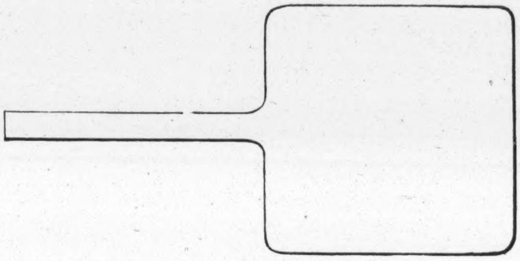


FIG. 6.

Loss plates are also made from high conductivity copper, but from a thicker sheet, so that they may last for some time. No great trouble need be taken with them, except to see that they are not put into the liquid when badly oxidised, in which case the free acid in the solution unites with the oxide on the plate, and the solution suffers in consequence, as I have already explained. For this reason, too, the loss plates should never be left in the solution when not in use, but should be taken out and placed in water with a few drops of H_2SO_4 added, or, if they are not likely to be required again for some time, they should be dried and laid aside.

(*To be concluded.*)

LEGAL.

United Telephone Company v. Equitable Telephone Company.—In the Chancery Division of the High Court of Justice, before Mr. Justice Chitty, the United Telephone Company brought action to restrain the defendant company from infringing its patents for telephones in which carbon is used, and came before the Court on a motion for an injunction till the trial of the action or further order. Our readers are familiar with the proceedings in past actions, where the plaintiff company has upheld the validity of its patent and succeeded in restraining various persons whom it was alleged infringed its patents. In December, 1886, the defendant company was registered, with a capital of some £6,000, for the manufacture and sale of telephone instruments. In the beginning of 1887 the directors wrote to the plaintiffs stating their intention to manufacture and sell the instruments, and they invited plaintiffs to come to their office and inspect the instrument, which was fitted up there. According to an affidavit made by the manager of the plaintiff company, he consulted the managing director upon the letter, and they determined not to take any notice of it, as they thought the company a bubble company, and that the notice was only intended as a threat, which would force the plaintiff company to bring an action for the purpose of retrying the validity of its patents. The defendant company, however, got into operation later on, and the plaintiffs, finding that the defendants were manufacturing and selling telephones which it was alleged were an infringement of the plaintiffs' patents, bought in December, 1887, and February, 1888, some of the defendants' instruments. The plaintiff company thereupon brought their action, and now made this motion, which the defendant company opposed on the ground of delay, and that the plaintiffs ought to have commenced the proceedings as soon as they had notice of what the defendants were going to do. Mr. Justice Chitty, after hearing the defendants' counsel, without calling for a reply from the plaintiffs, said the plaintiffs were entitled to an injunction. He held that on the affidavit of the plaintiffs' manager there had been no delay. They paid no attention to the notice of the defendants because they looked upon it as a mere threat, and did not think they would be justified in incurring the expense of legal proceedings because a mere threat had been made. If a man gave notice to the proprietor of an estate that he was going to cut down some of the trees on the estate, and the proprietor paid no attention to it, the man who gave the notice could not set up delay and acquiescence if the proprietor sought to restrain him when he did commence to cut down the trees more than a year after. The present case was very much like that. As soon as the plaintiffs found that the defendants were doing what they gave notice they would do, the plaintiffs brought their action and made this motion. An undertaking in damages was given by each side to the other.

King, Brown and Company v. The Brush Company.—Counsel for the parties in this action were heard before Lord Trayner in the Court of Session at Edinburgh on Saturday last. The discussion related to the numerous preliminary pleas stated for the defenders. On Tuesday his Lordship gave judgment in favour of Messrs. King, Brown and Company, repelling the whole of these pleas, and finding Messrs. King, Brown and Company entitled to the expenses of the discussion. The preliminary pleas related mainly to the question whether the Brush Company was subject to the jurisdiction of the Courts of Scotland, and whether the action there ought not to be stayed pending the result of the action raised in London by the Brush Company against the Orient Steamshipping Navigation Company, in one of whose ships Messrs. King, Brown and Company have fitted up the electric light. Lord Trayner's judgment is too long to be given at length; but we give the concluding part of it:—"I see no reason why the present case should be sisted pending the determination of another action in the Courts of England; an action which was only raised on the same day as the present, and an action to which the pursuers are not parties, and in which they have no concern. The defenders may just as well delay proceeding with the English case until this one has been determined."

ELECTRICAL FIRMS AND THEIR PUPILS.

MESSRS. R. E. CROMPTON & CO. invited their past and present pupils and a number of scientific friends to dinner at the Holborn Restaurant on Thursday evening last week. Amongst the assembled company we noticed the familiar faces of Profs. Hughes and Fleming, Mr. Spagnoletti, Mr. Macfarlane Gray, Sir Frederick Abel, Mr. Goolden, Mr. Callender, Mr. Mordey, Mr. Blackburne, Mr. Fowler, of Leeds, Mr. Willans, Mr. Gower, and others, together with representatives of the Technical Press and English and Colonial agents of the London and Chelmsford firm. After an admirably served dinner, a number of toasts, proposed alternately by Mr. Crompton and Mr. Albright, with music intervening, enlivened the proceedings, which terminated at 12 o'clock precisely.

Mr. Harrison, the Australian representative of Messrs. Crompton & Co., created considerable merriment by his reply to the toast of "Our Agents." He complained that although they possessed a vast tract of country, there was no population, comparatively speaking, to take interest in electric lighting, but this they hoped shortly to get, by legitimate means if possible. "Our Rivals," which Mr. Crompton proposed in most felicitous terms, was responded to by Messrs. Mordey and Blackburne in a few but well chosen words. Replies to the "Engineering Profession" were safe in the hands of Sir Frederick Abel and Mr. Fowler, and "Pure Science" was somewhat lengthily discussed by Prof. Fleming and Mr. Macfarlane Gray. Mr. Crompton made very complimentary and graceful allusions to the manner in which the Technical Press of this country had served the interests of the whole electrical profession in the endeavour to sift the wheat from the chaff, the good from the bad, the schemes which showed promise from those which carried their own condemnation from the beginning; and he censured in no measured terms the science (?) of the daily press, which he considered a disgrace to the supposed enlightenment of the present age. Suitable responses were made by Messrs. Beaumont and Biggs. It was made evident during the evening that the interests of the pupils of this firm are viewed by the principals as a very responsible part of their business, and that no endeavour is wanting on their side to send into the world really competent engineers who can be depended upon in any emergency at home or abroad. The students may be congratulated upon the fact that they are serving under such straightforward and honourable teachers, and the firm may be complimented upon the possession of so many young men who evidently show the determination of becoming successful engineers and men of business. The greatest good feeling appeared to prevail between Messrs. Crompton & Co. and all those with whom they have had business relations, and the fair and upright nature of their dealings with both friends and foes was the theme of all the speakers.

Such pleasant gatherings as these do much to foster good fellowship and cement the relation of employers to their assistants into a firm bond of friendship which will remain intact in after life, no matter by what distance they may be separated, and the annual dinner to past and present pupils will doubtless long continue and enable the principals and their students to learn still more of the "characteristics" of each. We must not omit to mention the admirable singing of Mr. Thos. Harrison, the London representative of Messrs. Davey, Paxman & Co., which did much to add to the enjoyment of the evening. Mr. Spagnoletti also, notwithstanding a severe cold, sang two songs to his own accompaniment.

NOTES.

To Advertisers and Correspondents.—We would remind our correspondents and advertisers that Good Friday occurs next week, and that we shall therefore go to press a day earlier than usual, publishing on Thursday morning.

Cheltenham and the Electric Light.—A special committee of the Cheltenham Town Council is considering the practicability of adopting the electric light for the illumination of the streets of the town. Mr. Swan delivered a lecture on the subject of electric lighting in the Corn Exchange last week in aid of the funds of the School of Science, evoking considerable interest.

Torquay and the Electric Light.—A meeting was held a week ago at Torquay, for the purpose of hearing an address from Mr. W. Radcliff, of London, on the advantages of electric lighting and the advisability of forming a limited liability company to promote this means of illumination at Torquay. Mr. Radcliff has been staying in the town for several months, and successfully introduced the electric light on the stage of the Torquay theatre. Most of those present were tradesmen and showed much interest in the subject. It appeared, from Mr. Radcliff's remarks, that his proposal is only to introduce the electric light into houses and business premises and not into the public streets. There would be no difficulty in raising the necessary capital in London, but by forming the company and supplying the electric light locally they would be getting it at cost price. He offered to put up the whole of the plant, and superintend its erection for a term of three years, free of all professional charge whatever, on condition that he received £50 a year for every one per cent. divided which the company paid. He did not propose any particular system, but to use what was best in all of them. Mr. O. S. Bartlett, solicitor, explained the legal formalities to be complied with in the event of it being decided to form a company. Mr. Callard proposed that a committee be formed to go into the question of cost, and also the sightliness of the wires, before they took any initiatory steps for the formation of a company. After further discussion, a resolution was carried: "That in the opinion of this meeting it is desirable to form an electric light and power company, and that a committee be appointed to consider fully the necessary details and report to a future meeting."

Railway Station Lighting.—The Midland Railway Company is now using the electric light (Thomson-Houston system) for lighting its St. Pancras Station and approaches, the booking and parcels offices, parcels yard, part of the hotel, and the fish and milk shed in the new goods depôt adjoining the station, being all brilliantly illuminated. Some 32 lights of 2,000 C.P. are employed, driven from a semi-fixed engine by Fowler, of Leeds. The work has been carried out by Messrs. Laing, Wharton and Down.

Dewsbury and the Electric Light.—At a meeting of the Dewsbury Town Council last week, the Town Hall and Officers' Committee agreed to communicate with electric lighting companies and contractors with the view of ascertaining the cost of an installation for the Town Hall.

The City and the Electric Light.—At the last fortnightly meeting of the Bishopsgate Ward Club, the following resolution was unanimously carried :—"That, in the opinion of this club, the City of London should be lighted by the electric light, and this club further considers that no contract for that purpose should be entered into which does not give the ratepayers the power of compulsory purchase."

Electric Lighting in the Navy.—The armoured cruiser *Galatea* is being fitted throughout with the electric light, the installation being that of Messrs. Siemens. Interesting experiments have recently been carried out in Simon's Bay to ascertain the distance at which the electric search light signals can be rendered legible. It was ascertained that Capetown, 20 miles distant, could be brought into communication with the fleet.

Lighting of Edinburgh Public Library.—A special meeting of the Edinburgh Public Library Committee was held last Saturday to consider the question of lighting the library by electricity. Councillor Dunlop, on behalf of the Building Committee, stated the result of a visit to Glasgow to inquire into the value of electricity as a means of lighting various public buildings in that city. They were very highly satisfied with what they had seen of the electric light in the bazaar and the City Hall, and they recommended that the system should be adopted for the Edinburgh Public Library. No doubt electricity was more expensive than gas, but it was much more satisfactory for their crowded rooms, and would not injure their books the same as gas. He strongly advised the committee to decide in favour of electricity as a means of lighting the library. Mr. George Mackay and Councillor Miller endorsed what had been said by Councillor Dunlop. Mr. Bryson, the electrician, read the specifications which he proposed for an installation to light all parts of the building, with the exception of the basement floor. The installation is to comprise 70 incandescent lamps of 16 candle-power, and 22 arc lamps of 1,000 candle-power, together with boilers, engines, and dynamos, and he estimated the total cost, including wages, at £400 per annum, that estimate also covering depreciation. It was remitted back to the sub-committee to consult with Mr. Bryson and Mr. Washington Browne, the architect, as to preparing specifications, and to procure estimates and report.

The Temesvar Installation.—The town of Temesvar, which was one of the first to adopt the electric light for its streets, is now about to extend it. At present the lighting is on the series system, using Brush dynamos, arc lamps, and groups of incandescent lamps; but as this system does not lend itself easily to indoor use, where each lamp must be under independent control, a scheme has been elaborated by the resident electrician for the use of alternating current machines and transformers. The particular type of transformer to be used is that made by Messrs. Kremenezky, Mayer & Co. (the Anglo-American Brush Corporation).

Electric Light in the Isle of Man.—The Falcon Cliff Hotel and the adjoining grounds at Douglas, Isle of Man, have been fitted up with a total of 400 incandescent lamps and 10 arcs by Messrs. C. H. Baker & Co., Limited, of Manchester. They employ their own new patent arc lamps and their special type of dynamo for both arcs and incandescents. The switch boards and other accessories are also made by the contracting firm. The engine and boiler, which are of the semi-portable type, are of 60 horse-power. We believe this is the second large Douglas hotel to adopt the electric light.

Electric Lighting in Vienna.—A very interesting electric light installation was started at the beginning of this month at the Künstlerhaus, where a jubilee exhibition of pictures is now being held. In making the installation, according to *Industries*, care was taken to arrange the lighting in such a way that the current might at a future time be supplied from a central station. At present the current is supplied by engines and dynamos erected in a shed some distance behind the premises. The motive power consists of two semi-portable engines, each of about 400 square feet heating surface, one supplied by Marshall, Sons & Co.—the other by the Austrain State railway works. Each engine drives a large Drexler dynamo, which is a close imitation of the Hopkinson type. The machines are shunt wound, and have bar armatures, the output being 800 ampères at 70 volts. The circuits from the engine-house consist of four naked copper cables ·86 inch diameter, carried on posts and insulators over the roof of an intervening house to about the middle of the roof of the Künstlerhaus, below which point is fixed the distributing switchboard. The installation comprises 70 arcs for indoor use, 8 arcs for outdoor use, and a trophy of 30 glow lamps. All the arc lamps are arranged in parallel, and are of different candle-power, consuming 10, 12, and 15 ampères, according to the special artistic effects required. For lighting the buffet, and some rooms without windows, there is a second small plant of gas engine, dynamo, and eight arc lamps in series. The installation has been erected by Messrs. B. Egger & Co., of Vienna, under the superintendence of Herr von Pichler, the engineer to the Künstlerhaus. Immediately over the engine-house about 200 telegraph and telephone wires pass; but as yet no disturbance from the heavy currents has been noticed in these wires.

Electric Lighting in Russia.—*Money* has a correspondent in St. Petersburg, and he has sent over some interesting information regarding the exhibition there of methods of illumination, and incidentally regarding electric lighting generally in Russia. At the outset he says the exhibition demonstrates the ability of gas to hold its own against the electric light, and proceeds :—"The first impulse to modern electric lighting came, as is well known, from Russia, and since Jablochkoff made his first successful experiments in St. Petersburg, the Government and the municipal bodies of Russia, infinitely readier to accept new ideas and encourage inventors than the administration and local bodies of this country, have given it so much support that one would expect to find electric lighting very well represented, and in extensive use in Russia. The contrary, however, is the case. The Nevsky and two or three thoroughfares possess the light, and a few shops, hotels, and palaces are lit with it; but, generally, it is unpopular in Russia on account of its dearness—particularly in St. Petersburg—and, if anything, has rather retrograded than developed during the last twelvemonth. This retrogression is illustrated in the electric display at the Exhibition, which has a starved look about it, notwithstanding the favour shown it by the Imperial Technical Society. So unpopular is the light that it is a question whether the display has led to the slightest accession of business to the electric lighting firms. The case is very different with the display of gas and lamps. In both there are evidences of prosperity, of startling progress, and of improvements in cheapness and intensity of light that cannot but strike the most indifferent observer. . . . . Clearly enough, the Exhibition shows that the competition at present is rather between gas and oil than between gas and electricity." In a note in another part of the same issue of *Money*, it is stated that the Russian Government has carried out experiments with the view of testing the relative cost of oil, gas and electricity. Electricity is more than twice as dear as gas, and seven times as dear as kerosine. A new duty is to be imposed upon kerosine, bringing the cost of gas and oil about equal. The St. Petersburg gas companies are displaying great energy in securing the latest improvements from abroad, and make a special point of fighting electricity by encouraging the use, at cheap rates, of installations of huge lights of the regenerative character.

Lighting of Theatres.—They are so much more practical in Paris than in London, says the *Pall Mall Gazette*. In Paris there is a Commission now sitting to decide whether gas should not be abolished at theatres and the electric light substituted. The Commission all started this week for the electric laboratory at Grenelle, where a competent lecturer told them a great deal that was surprising, and showed them still more extraordinary experiments. All sorts of inflammable materials, silk, calico, canvas, chips of wood, and edges of old scenery were brought in contact with the light and showed no tendency to catch fire. There were conditions indeed in which the flame could be communicated, but it was extremely difficult to produce them.

In a paper read before the International Society of Electricians, M. Am. Vernes pointed out the dangers incurred from an installation carelessly put up and indifferently insulated. He showed that the two prime sources of risk lay in moisture and bad joints, and demonstrated how easy it was to avoid both these elements of peril. During the lecture practical illustrations were given of the effects of moisture, bad joints, breaking of lamps, &c.

The Bell Patent in America.—A *Times* telegram from Philadelphia, dated March 19th, states that the United States Supreme Court has disposed of the long pending telephone cases by affirming the validity of the Bell telephone patents. Three judges, Justices Bradley, Harlan, and Field, dissent from this decision.

Telephone for Ailsa Craig Lighthouse.—To obviate a difficulty in the working of the fog signals on Ailsa Craig, the Commissioners of Northern Lighthouses are just about to connect the two fog horns on the island with the engine room at the lighthouse by telephone. To complete the system of lighthouse and fog horn signalling, a telegraph cable from Ailsa Craig to Girvan, the nearest station, is necessary, and this, it is understood, is in contemplation.

Beith and the Telephone.—The National Telephone Company is annexing town after town in its telephonic crusade in the North. Beith, in the Burns country, seems about to succumb to the wiles of the invader, and accept an exchange. It will never regret it, if it does.

Western Union Cables Repaired.—The Western Union Telegraph Company gave notice at the beginning of the week that communication by its cables to America, which was interrupted by the great storm on the east coast of that country, had been fully restored.

Royal Meteorological Society.—At Wednesday evening's meeting of this society an address was delivered by the President, Dr. Marcet, on "Atmospheric Electricity," illustrated by some interesting experiments. The delivery of this discourse was followed by the reading of a paper by Mr. G. J. Symons, on the "Non-Existence of Thunderbolts," the object of which was to abolish the common use of the term as a fiction unworthy of modern knowledge. The flash of lightning is nothing but a large electric spark, an equalisation of potential between two unequally or differently electrified bodies; and there is no more transmission of a thunderbolt in a storm than there is actual transmission of material substance when we send a message across the Atlantic. After the usual votes of thanks the meeting adjourned to the library and adjoining rooms, where a large and most interesting collection of apparatus connected with atmospheric electricity had been brought together, and amongst which particularly noticeable were numerous photographs of lightning taken during storms.

Red Sea Cables.—The Eastern Telegraph Company announces that the Perim-Suakim cable is repaired, and communication with Suakim restored.

Schanschieff Electric Light and Power Company, Limited.—This is the title of a new company registered this week to take over from the Schanschieff Electric Battery Company, registered on August 18th last year with a capital of £25,000, the patent rights in the United Kingdom, France, Belgium, Germany, Italy, the United States and India, for the Schanschieff single liquid battery. When we first saw the announcement of the registration of this company, we were literally startled to read that the proposed capital was £200,000. That so large a sum could be required to work a primary battery business seemed impossible. We have since learned, however, that no less than £120,000 will be immediateiy absorbed by the vendors. The consideration to be given by the new company to the old for the patent rights above mentioned, consists of £50,000 absolutely in shares, £70,000 either wholly in shares or partly in shares and partly in cash, and half the proceeds which may arise upon the sale of the foreign patents, or upon licenses to use outside the United Kingdom. This arrangement fills us with forebodings for the future of the company. The Schanschieff battery is undoubtedly a very good one in its way, but to saddle the company with such an outrageous burden at the outset will be to make it, if not altogether impossible, at any rate extremely difficult, to earn anything like a reasonable dividend. We regret to see so good a thing treated in such a manner.

Another Fatal Theatre Fire.—The Baquet Theatre at Oporto was completely destroyed by fire on Tuesday night, the conflagration being caused by a gas accident which occurred during the last act. There was a very full house at the time. The number of those supposed to have perished was calculated next day at 80, but it has since seemed probable that the death roll is of much larger proportions. We have said so much already, and quite recently, upon the subject of these horrible theatre fires that there is little need, in the face of one more terrible sacrifice of human life, to repeat our comments. The story of this fire, as told in the daily papers, cannot conceivably leave a doubt that gas is doomed for theatre illumination, and that the use of the electric light must for this purpose become universal. May the good day come soon!

Tenders.—The Manchester, Sheffield, and Lincolnshire Railway Company invites tenders for the supply during the year ending April 30th, 1889, of signal and telegraph material, of which specifications may be obtained from Mr. E. Ross, London Road Station, Manchester.

Piracy or Adaptation?—Our attention has been called to a remarkable similarity between the illustration in the *Electrical World* of March 10th of the Silvey dynamo and the illustration of the Kapp dynamo in Mr. Kapp's "Electric Transmission of Energy." The description of the Silvey machine in the *Electrical World* is prefaced by the remark that, although resembling somewhat that designed by Kapp, it contains some modifications of detail. These modifications are invisible to the naked eye upon a comparison of the two blocks; in fact, the American block is an evident reproduction of the other. Stay! there is one difference—a difference of merest detail, perhaps: in Kapp's book the base of the machine has shown upon it the names of the makers, "W. H. Allen & Co., London," whereas the base of that pictured in the *Electrical World* bears the legend, "Silvey Dynamo"!

Lecture.—Prof. Silvanus Thompson lectured at the Royal Victoria Hall last week on "Electric Bells." Towards the close of his lecture he made reference to other forms of the utilisation of electric power.

Coincidences.—One could readily recall a number of instances in which valuable electrical inventions have been made by men who dabbled in the subject as amateurs only. The relation between hat machinery and dynamo manufacturing does not, at the first glance, seem very apparent, yet Mr. Eickemeyer was originally a designer of overhead gear.

Alternate-Current Transformers.—A letter upon this subject has reached us at a late hour from Mr. E. Manville, who says :—"I notice in your late issues a series of reports of the discussion on the above subject at the Society of Telegraph-Engineers and Electricians, which took place during my absence in America. Both Mr. Gordon and Mr. Crompton seem to be extremely doubtful of the possibilities of an alternating system, assuming certain details of working on which the efficiency of the system must depend to be impracticable. I allude to the coupling up of alternating machines in parallel, and the use of small machines instead of large ones. My company having interests in this system of distribution of electricity, I inspected several stations in the States equipped with complete Westinghouse plants. The practice in all of them was to use small dynamos, each dynamo running off a separate Westinghouse engine, the power being transmitted through a belt. They would have in the daytime a sufficient number of machines running to just supply the required current (thus obtaining a maximum efficiency of both engine and dynamo), and as the demand for current increases, more machines are connected in parallel to the working system. The method of connecting in parallel has been brought to a simplicity that leaves nothing to be desired. The already working system, and the fresh dynamo that is to be added to it, are connected to two circuits on a small piece of apparatus, showing by two lamps the difference of phase of the two currents. Each lamp varies from a maximum brilliancy to 'black out,' at a comparatively slow rate and not coincidentally. The 'beats' of the lamps alter in respect to each other until in a few seconds the lamps go out and attain their maximum brilliancy at the same time. When this point is reached the switch is put up, and the machines are running in parallel without any disturbance taking place. Looking at the machine that is about to be switched on, the only evident sign at the moment of connection is a tightening of the belt from the load placed on it. One is bound to conclude, therefore, that 'the bottom has been knocked out' of many of the arguments used in the course of the discussions above referred to, and that the consensus of opinion in this country in favour of distribution by means of transformers is fully justified and strengthened by what is being achieved daily in America."

A Lamp Life of 9,700 Hours.—We recently published a note upon the long life of an incandescent lamp (5,292 hours). Ensign Gilbert Wilkes, of the U.S. Navy gives the following fact as one of interest in this connection. When the U.S.S. *Trenton* returned from China in September, 1886, one Edison lamp, of which, together with many others, a very careful record was kept, had burned 9,700 hours, and was still in good condition. Several other lamps had been burned out in the same fixture before this lamp was put in.

The Electro-Harmonic Society.—The last smoking concert of the season 1887–1888 will take place at the usual *rendezvous* on Friday evening, April 6th. An innovation in entertainments of the kind will be made, a string quartette, performing works of Mozart and Haydn, taking the place of the usual glee party. Violin duets, which some decades since were so fashionable, but which are now rarely heard, will also be played, and the vocal element will be ably sustained by Messrs. Arthur Thompson and Robert Hilton and Master Humm. Altogether we look forward to an evening's pleasure which will be in its style unique.

Barcelona Exhibition.—It was intended to open this exhibition on the 8th of April, but it is now evident that it will be scarcely in a sufficiently forward condition even by the 17th of May—the King's birthday—which is now spoken of as the date of opening.

Communication Between Lighthouses and the Shore.—The important question of providing telegraphic communication between lighthouses and the shore is not being allowed to rest. It was the subject of a resolution on Saturday at a meeting of the Plymouth branch of the National Lifeboat Institution, when Mr. Bayly, who will again bring the matter forward at the next annual meeting of the Associated Chambers of Commerce, proposed :—"That this meeting urges the President and the Committee of the National Lifeboat Institution in London to further by every means in their power the movement which has been set on foot by the Associated Chambers of Commerce to establish electrical communication with lighthouses, coastguard stations, and lightships at all salient and practical points on the coasts of the United Kingdom." The only difficulty was that of expense, but that would be amply outweighed by the saving of life and property which must result from the establishment of the telegraphic communication which was so much needed between lighthouses and the shore. Mr. Bayly remarked that, contrary to expectation, the Sunk lightship experiments had shown that the telephone acted perfectly in the most stormy weather. The resolution was unanimously carried.

Changes.—The registered offices of the National Telephone Company will be removed on the 24th inst. to 162A, Queen Victoria Street.

Messrs. Thompson, Ritchie, & Co.'s address after this week will be Connaught Mansions, Victoria Street, Westminster.

Society of Telegraph Engineers and Electricians.—A students' meeting was held on Friday last, the 16th inst., Mr. W. M. Mordey presiding. Mr. Mordey made some remarks in regard to arbitrary units, and explained the system adopted by the Anglo-American Brush Electric Light Corporation for numbering wires and leads. Mr. A. Dykes opened a discussion upon transformers, which was continued by Messrs. Smith, Lamb, Cooper, Tidd, Collis, Zingler, and Mordey.

Quick-Speed Drilling Machine.—A new patent high-speed drilling machine has just been brought out by Messrs. Selig, Sonnenthal & Co., which they call the "Victoria," and as it appears to possess considerable advantages, our readers may be glad to investigate its nature for themselves. The machine is strongly and accurately made, so as to meet every requirement for the drilling of small holes from $\frac{1}{64}$th to $\frac{3}{8}$th.

Seel Lamps.—The company which manufactures the Seel glow lamp at Berlin is about to considerably enlarge its works. With the new plant, the time required to evacuate the lamps is much reduced, and the loss of quicksilver, sometimes occurring through breakage of the old Sprengel pumps, is also said to be avoided. It was often found that when a pump broke, quicksilver found its way into the clothing of the workpeople, and to protect them from such accidents, which are prejudicial to health, the pumps will be placed outside the workrooms.

The British Association.—At the Bath meeting of the British Association, which will begin on September 5th, Prof. Schuster will preside in Section A (Mathematics and Physics) ; Prof. Tilden in Section B (Chemistry) ; Prof. Boyd Dawkins in Section C (Geology) ; Mr. Thiselton Dyer in Section D (Biology) ; Col. Sir C. W. Wilson in Section E (Geography) ; Lord Bramwell in Section F (Economic Science and Statistics) ; Mr. W. H. Preece in Section G (Mechanical Science) ; and General Pitt-Rivers in Section H (Anthropology).

Personal.—Mr. A. Laing and Mr. J. Aitken, of the Telegraph Department, General Post Office, left Edinburgh last week on their way for Durban, to fill posts under the Natal Government.

Improved Electric Bell.—An electro-magnetic bell in which a long stroke of the bell hammer may be obtained, to produce an effective alarm without the employment of spring or weight mechanism, has been patented in America by Mr. William F. Stocker. Combined with a bell hammer lever, pivoted in a frame of special construction, are one or more electro-magnetic armatures, and one or more helices adapted to receive the armatures within their coils, either the armatures or the helices being carried by the bell hammer lever. By providing a long stroke of the electro-magnet or polarised armature, a powerful blow of the hammer upon the bell is obtained, and as the device is designed for heavy work, it is desirable to place it in a local circuit provided with a strong battery, operating the local circuit by means of a relay.

The Vienna Electrical Laboratory.—The programme of this undertaking has been issued by the directors of the Technological Museum, of which the laboratory forms a recently added section. The work will be superintended by Herr Carl Schlenk, and is to embrace experimental investigations of dynamos as regards output, power consumed, efficiency, and other matters; investigations and reports on executed installations for lighting, power, or chemical purposes, photometry of arc and glow lamps, calibration of measuring instruments, and investigations of primary and secondary batteries. A tariff has been fixed for the work, which will presumably be required very frequently. Thus for testing a dynamo the charge will be from £1 4s. to £4, according to size of machine; for testing a glow lamp, 16s. to £1 4s.; arc lamp, £1 4s. to £1 12s.; calibration of instruments, 5s. to £1 12s. Members of the Museum obtain a discount of 25 per cent. off these charges. Where the work is of special nature or for outside work the charge is to be agreed upon beforehand. These fees are levied primarily with the object of covering working expenses. Any surplus is to be equally divided between the exchequer of the Museum and the staff of the laboratory.

NEW COMPANIES REGISTERED.

Bentham Gas Company, Limited.—Capital: £2,000 in £5 shares. Objects: To manufacture and supply gas and electricity in the town of High Bentham and elsewhere in the parish of Bentham, York, and to establish and work stations for the generation and distribution of the electric current, and to carry on the business of a gasworks and electric light company in all branches. Signatories (all of Bentham): Wm. Knowles, J. Marshall, J. Procter, T. Wilcock, F. H. Holmes, W. Greenip, J. Jackman, T. Knowles, T. Eaton, C. J. Knowles, 10 shares each; J. Foster, 5 shares. Registered, without articles of association, on the 17th inst. by Tahourdins and Hargraves, 1, Victoria Street, Westminster.

Julien Electric Company, Limited.—Capital, £100,000 in £10 shares. Objects: To acquire and work the following British patents, viz., 1885, No. 8,881, for improvements in secondary batteries, part of which is applicable to primary batteries; 1886, No. 2,470, for improvements in electrical locomotion, propulsion, or traction, and the apparatus therefor; and also the benefit of an application for letters patent, 1887, No. 8,855, for improvements in and appertaining to electric piles and plates therefor. Signatories (with 1 share each): A. W. Kipping, 9, Woodville Road, Islington; R. R. P. Braithwaite, 56, Osnaburgh Street, N.W.; A. F. Stoke, 5, Birchin Lane; T. B. Weare, 50, Devonshire Chambers, Bishopsgate Street; A. Burton, 30, Malvern Road, Dalston; R. Gordon, New Malden, Surrey; A. G. Pavill, Thornton Heath. The signatories are to appoint the first directors. Qualification: £200 in shares, stock, or debentures. Remuneration: £100 per annum to each director, with an additional £100 for the chairman. Registered 19th inst. by Walter Webb & Co., 23, Queen Victoria Street. Registered office, 63, Finsbury Pavement.

Schanschieff Electric Light and Power Company, Limited.—Capital, £200,000, in £5 shares. Objects: To acquire and work patents relating to improvements in galvanic batteries, and in saline and other preparations to be used therewith, and also for improvements in miners' safety lamps and galvanic batteries for use in connection therewith. Signatories (with 1 share each); *Earl of Cathcart, 31, Grosvenor Place; *Wilberforce Bryant, Stoke Park, Bucks; *Lieut.-Col. the Hon. H. W. Campbell, 44, Charles Street, Berkeley Square; F. A. Govett, 24, Gledhow Gardens, S.W.; F. H. H. Samuel, 1, Whittington Avenue, Leadenhall Street; S. de Lissa, 64, Onslow Gardens; J. G. Bristow, 1, Copthall Buildings. The signatories denoted by an asterisk and Mr. David Marks are the first directors. Qualification: £500 in shares or stock; remuneration, £500 per annum to chairman and £400 per annum to each other director. Registered 20th inst. by Wilson Bristows & Carpmael, 1, Copthall Buildings.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Oppermann Electric Lighting and Manufacturing Company, Limited.—The final meeting of this company was held at the registered office, Astral Works, Blockley, Worcestershire, on the 13th inst., when the following resolution was proposed by the chairman (Lord E. S. Churchill) and seconded by the Rev. H. Barter, viz.:—That the report and account submitted to the meeting showing the manner in which the winding up has been conducted be received and adopted. The resolution was carried unanimously, and was duly registered on the 16th inst.

Armstrong's Electric Light and Power Company, Limited.—The statutory return of this company, made up to the 12th inst., was filed on the 19th inst. The nominal capital is £20,000 in £1 shares. 11,137 shares have been allotted, and of these 9,500 are considered as paid up. Upon 1,630 shares the sum of £1,222 10s. has been called up, and upon 7 shares the full amount has been called. The calls paid amount to £852 10s. and unpaid to £377. Registered office, 9, Bridge Street, Westminster.

Charles L. Baker & Co., Limited.—The registered office of this company is at 2, Clarence Buildings, Bath Street, Manchester.

CITY NOTES, REPORTS, MEETINGS, &c.

German Union Telegraph Company, Limited.

The seventeenth ordinary general meeting of this company was held at Winchester House on Monday, Sir James Anderson, the chairman, presiding.

Mr. Paton, the secretary, having read the notice convening the meeting, and the minutes of previous meetings having been read and confirmed,

The Chairman said: When I last addressed you I told you all that was to be said about the offer of the German Government for the purchase of our cables, and we were authorised to accept the terms offered. Notwithstanding that the offer was generally favourable, there was a large amount of reserve about which we thought we should like to know more than was specified, and with this end in view your solicitor, Mr. Burt, your secretary, Mr. Paton, and myself went to Berlin last month, believing that we might possibly forward the shareholders' interest by getting more of that reserve than was at first anticipated. It was a large sum, something like £25,000, and there were important agreements which had to be met, some of them having existed for a period of 11 or 12 years. Naturally those gentlemen who had entered into those agreements would have liked to get all they possibly could, and we thought we might give them what was perfectly equitable and fair, and still get something out of the large sum. I am happy to say we succeeded in that, not of course without some little warmth and discussion. We fought with good friends, however, and we are about £10,000 better off than when we left here. We also agreed about the rent of our offices in Berlin, about the expense of liquidation, and about the stamps and every item that your solicitor or secretary could think of as likely to dip into this reserve, so that we can say with some accuracy now that we think that if all goes well we shall pay you within 1s. or 1s. 6d. of par. That depends of course upon the expense of repairs and breakages that may be necessary between this and this time next year. One cable is broken just now, and the *Britannia* is on the spot waiting for two or three fine days to effect the repairs. We parted from our German colleagues good friends, and I hope we shall not have to go back there again. You get your dividend to-day of 8s. 3d., and there will be no further dividend until you get three-fourths of your capital back, which will, I believe, be in January next; the final distribution of capital will be in the following April. There is a meeting to be held in Berlin on the 27th of this month, which will be the final meeting there to arrange about the liquidation, but as we were all agreed the other day at Berlin, I hope we shall not have to go there, for our views will be represented there by gentlemen who hold power of attorney. There is nothing more to be said about the matter. This is perhaps the last meeting but one of the German Union Telegraph Company, and I am very sorry it is to be so, for the company seemed to be going on very well until the Government threw us over. It is now my duty for the last time to move that the report and accounts for the year to December 31st, 1887, be and are hereby received and adopted, and that a dividend of 8s. 3d. per share, payable this day, be declared, making, with the present distribution, a total dividend for the year of 14s. This is at the rate of 7 per cent. per annum, as compared with 6 per cent. last year.

Mr. Ericssen seconded the resolution, which, after the chairman had answered a query to the effect that the final distribution of capital would include whatever dividend might be payable up to the end of December 31st, 1888, was unanimously carried.

The retiring director, Mr. Ericssen, and the auditors, were then re-elected, and the meeting terminated with the passing of a cordial vote of thanks to the chairman and directors and other officers of the company.

The Direct Spanish Telegraph Company, Limited.

THE accounts for the half-year ended December 31st, 1887, show, after providing for debenture interest and the balance of the charge for renewal of the shore-end of the cable at Marseilles, a balance to the credit of profit and loss of £5,564 9s. 10d.

The traffic receipts are in excess of those for any half-year since the formation of the company, and show an increase of £1,338 12s. 10d. as compared with the corresponding half-year of 1886. This increase of traffic has necessitated only a moderate amount of additional expenditure.

The company's cables and the land-lines in connection with them have continued in good working order throughout the half-year. The Spanish Government Telegraph Administration, recognising the importance of the cable communication between Spain and England, has erected a new wire, of the most improved type, between Bilbao and Madrid, to be used exclusively for the cable work of this company, and this will, no doubt, beneficially affect the traffic.

After putting £2,500 of the balance of profit and loss to the reserve fund, which now amounts to £8,447 19s. 1d., there remains £3,064 9s. 10d. available for dividends. The directors recommend the payment of the dividend at the rate of 10 per cent. per annum on the preference shares, and a dividend of 2¾ per cent. (free of income-tax) for the half-year upon the ordinary shares, making, with the previous distribution, 4 per cent. for the year 1887, and to carry forward £185 16s. 8d. The dividend warrants will be issued on April 3rd.

The Eastern Telegraph Company, Limited.—The directors announce the payment, on April 14th next, of a dividend of 3s. per share on the preference shares of the company, less income tax, for the quarter ending March 31st, 1888, and an interim dividend of 2s. 6d per share on the ordinary shares of the company, free of income tax, in respect of profits for the quarter ended December 31st, 1887.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending March 16th, 1888, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £4,181.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 15th March are £3,333, as compared with £3,278 in the corresponding period of 1887.

The Brazilian Submarine Telegraph Company, Limited. The traffic receipts for week ending March 16th amounted to £4,979.

NEW PATENTS—1887.

15878A. "New or improved apparatus for measuring the time during which a current of electricity or other fluid is flowing." V. POPP. Dated November 18.

15878B. "Improvements in fluid meters." V. POPP. Dated November 18.

1888.

3670. "A volt indicator." A. SIEMENS. Dated March 9.

3672. "Means or appliances for use in connection with electric circuits or water or gas supplies or the like, to enable a supply of electricity for lighting or other purposes, or a supply of water or gas, or the like, to be obtained on the deposit of an equivalent therefor in the shape of prepayment or otherwise." H. EDMUNDS. Dated March 9.

3678. "Improvements in and relating to electrical signalling on railways and in apparatus therefor." W. G. OLPHERTS. Dated March 9. (*Complete.*)

3685. "Improvements in electrical switches." S. SHARP, J. M. V. MONEY-KENT, and H. J. PAYNE. Dated March 9. (*Complete.*)

3690. "Improvements in railway electrical signalling apparatus." E. DUNN. Dated March 10.

3710. "Improvements in electro-magnetic motors." J. TWEEDDALE. Dated March 10.

3714. "Improvements in electric fittings." A. C. COCKBURN and F. DAY. Dated March 10.

3766. "An improved form of communicator and collectors for dynamo-electric machines and electric motors." G. J. BALDWIN. Dated March 10.

3812. "An improved combined switch and holder for electrical incandescence or glow lamps." E. L. BERRY and G. FRANKE. Dated March 12.

3835. "Improvements in telegraphic apparatus." H. P. COPELAND. Dated March 13. (*Complete.*)

3841. "Improvements in telephonic apparatus." T. LAURIE. Dated March 13.

3883. "Improvements in electrical devices for type-writers." A. J. BOULT. (Communicated by J. F. McLaughlin, United States.) Dated March 13. (*Complete.*)

3921. "Improvements in apparatus for indicating, measuring, and controlling electrical currents." T. PARKER, E. SCOTT, G. REES, and J. H. WOODWARD. Dated March 14.

3929. "Improvements in and relating to dynamo-electric machines." T. PARKER, E. SCOTT, G. REES, and J. H. WOODWARD. Dated March 14.

3968. "Regulation of feed of arc lamps." J. W. KING. Dated March 14.

3979. "Improved construction of plates and arrangement of fastenings for connecting them in voltaic order for medico-electric purposes." W. G. JOHNSON. Dated March 14.

3986. "An improvement in plates for secondary voltaic batteries." B. M. DRAKE and J. M. GORHAM. Dated March 14.

3995. "Improvements in and relating to galvanic batteries." H. H. LAKE. (Communicated by H. Walter, United States.) Dated March 15. (*Complete.*)

3998. "An improved electrical indicator for the locking apparatus connected with railway points." T. C. R. HORSFIELD and R. PORTER. Dated March 15.

4008. "Improvements in electric batteries." H. ULLATHORNE and C. GAUZENTES. Dated March 15.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1887.

893. "An electrical billiard marking repeater and indicator." G. W. HOOK. Dated January 20. 6d. Relates to an electrical billiard marking repeater and indicator, for electrically indicating at any distance from the billiard-room the progress of the game from the unit 1 to any figure. There is 1 claim.

1693. "Improvements in disc dynamo or magneto-electric machines." C. D. ABEL. (Communicated from abroad by La Compagnie Continentale Edison, of Paris.) Dated February 2. 11d. According to this invention the disc armature is formed by a series of coils grouped round a central shaft, each coil being formed by a split copper band, of which the two parts are bent away from each other, and are bent into polygonal form. This arrangement has the following advantages: it allows the same extent of surface to be given to each coil, one half being on one side of the armature, and the other on the other side; the several coils can thus join on to one another, so as to form a disc with the greatest possible number of coils, while at the same time the disc armature is kept very thin, and consequently the poles of the opposite magnets can be brought very close together, and have a correspondingly powerful effect upon the armature. The claims are 14 in number.

9645. "Improvements in the method of and apparatus for applying electricity to steam and other boilers, compressed air machines, and gasometers for the prevention of explosions, and also for automatically supplying the feed water to boilers." F. Martenot. Dated July 8. 8d. Claims:—1. The application (in the manner herein described) of applying electricity to steam boilers, compressed air machines, gasometers, and other analogous receptacles, with the view of preventing explosions by the means specified. 2. The construction of the apparatus for the employment of electric currents, as represented in the accompanying drawings, in two separate forms, which consist in effecting automatically the ungearing of a wheel and lever, by aid of a counterweight, which effects (by the means already described), on the one hand, the escape of the excess of steam, gas, compressed air, and so forth; on the other hand, the introduction of the requisite supply of feed water to boilers in the manner, by the means, and for the purposes precisely as explained and as illustrated by the drawings.

9743. "Improvements in or connected with incandescent electric lamp sockets." W. P. Thompson. (Communicated from abroad by G. Westinghouse, jun., of America.) Dated July 12. 8d. The object of the invention is to provide a simple and efficient combination socket and circuit controller, one which is cheap to manufacture, which is not liable to get out of order, and in which the parts are efficiently insulated. The claims are 9 in number.

9876. "Improvements in and relating to dynamo-electric machines." R. Dick and Rankin Kennedy. Dated July 14. 8d. Claims:—1. The construction, or arrangement and combination of the parts of a dynamo-electric generator for producing currents of alternating polarity of either high or low tension or electromotive force, all substantially as described, in reference to the drawings. 2. In alternating current dynamo-electric machines, the forming of fixed radial field magnets, having poles of opposite polarity facing each other, that is, two north and two south poles facing each other alternately round the traverse of the armature, all substantially as, and for the advantages described in reference to, and shown in the drawings.

10056. "Improved contact apparatus for use in automatic electric signalling on railways." W. Walker. Dated July 18. 8d. Relates to special constructions and arrangements of contact apparatus, which the inventor prefers to use in carrying out his system of automatic electric signalling, and by means of which apparatus he is enabled to establish and maintain certain and perfect electrical contact for the purpose set forth.

10092. "An improved insulating material especially adapted for covering electrical conductors." R. W. Eddison. (Communicated from abroad by J. Tatham, of America.) Dated July 19. 4d. Claims: 1. An insulating material or compound consisting of or containing rosin and cotton seed oil in the proportions of from four to six parts by weight of rosin to one part of cotton seed oil, all substantially as specified. 2. An insulating material or compound consisting of or containing rosin and cotton seed oil incorporated together with or without other ingredients, substantially as and for the purpose described.

10217. "Improvements in galvanic batteries." J. Serson and J. O. Whitten. Dated July 21. 8d. Relates more especially to that class of galvanic batteries which are provided with feeders or re-enforcing cups, and it consists in a novel construction and arrangement of parts as set forth, the object being to produce a more effective and otherwise desirable device of this character than is now in ordinary use. The claims are 10 in number.

10716. "Improvements in electric alarm apparatus." T. M. Knight. Dated August 4. 6d. Claims:—1. As a new article of manufacture a fabric to be used on structures to render an alarm in case of abnormal conditions, the said fabric consisting of woven or like fabric containing a series of bare wires formed therewith, as set forth. 2. As a covering for structures to insure alarm in case of abnormal conditions, the two layers of wire fabric constructed as described, in combination with the interposed layer of paper or analogous bibulous substance, the series of wire in one layer crossing those in the other, as set forth. 3. As a new article of manufacture, a fabric to be used on structures to render an alarm in case of abnormal conditions, consisting of a woven or like material containing a series of wires formed therewith, as set forth.

10933. "Improvement in means or material employed for insulating electric currents." D. S. Robertshaw and R. F. Sunderland. Dated August 10. 4d. Claim:—The employment and use of paper sheet or board of sufficient thickness to insulate the different parts of electrical instruments or machines, substantially as and for the purposes set forth.

11129. "Improvements in electro-magnetic telephones." H. Collet. Dated August 15. 6d. Claim:—In an electro-magnetic telephone, winding the magnet with two or more coils, all in the main circuit, and one or more of which forms part of a shunt circuit connecting the poles of a battery in the main line, while the other coil or coils are placed directly in the main line, and do not form part of such shunt circuit, and arranged substantially in the manner described.

11181. "Improvements in printing telegraphs." J. H. Linville. Dated August 16. 2s. Relates especially to that class of printing telegraphs operating automatically either as transmitters or receivers, by electrical pulsations sent from any instrument organised as a transmitter over a conductor connected with one or more similar instruments organised as receivers when the type wheel shaft is driven by any suitable motive power. Further relates to the application of a motor to automatically wind a spring which rotates the type wheel shaft, and to the use of two type wheels in page printing telegraphy, whereby through suitable shifting devices the impressions upon the paper from either wheel may be made in the same continuous line; and to improved apparatus for presenting the paper in page form from a continuous roll to the type wheels; and to electric magnetic devices and circuits to operate the type wheels, to unison the type wheels and paper carriages, and to effect impressions. The general object of the invention is to diminish the cost, increase the rapidity and certainty of such apparatus, to obviate the necessity of winding the motive power by hand, and to provide improved means of maintaining synchronism between the pulsator and the type wheels of the instrument employed as a transmitter, and the type wheels of the instruments employed as receivers, whereby their synchronous movement is automatically adjusted, when necessary, once in each revolution by an electro-magnet responding to pulsations of twice the ordinary length required to rotate the type wheels, without retarding the regular motion of the type wheels of the transmitter, and to effect the requisite operations over a main conductor by the aid of local batteries, using in all the operations currents of similar polarity. The claims are 48 in number.

11188. "Improvements relating to the conversion of chemical energy into electrical energy and to apparatus therefor." H. H. Lake. (Communicated from abroad by W. E. Case, of America.) Dated Aug. 16. 8d. Claims:—1. The improvement in the art of converting chemical energy into electrical energy, which consists in chemically attacking carbon in a galvanic cell without the application of heat. 2. The improvement in the art of converting chemical energy into electrical energy, which consists in subjecting carbon to the action of an unstable oxygen compound in a galvanic cell without the application of heat. 3. A galvanic cell containing a positive element of carbon, and an electrolyte in which by the exercise of the chemical affinity of its constituents, is formed a gas containing oxygen in unstable combination and capable of reacting on said carbon without the application of heat. 4. The improvement in the art of converting chemical energy into electrical energy, which consists in oxidising an element of carbon in a galvanic cell, and thereby producing an electric current in a circuit, including the electrolyte and other element of said cell, by adding chlorate of potash to sulphuric acid in said cell, in which acid said elements are immersed and thereby forming per-oxide of chlorine in the presence of said carbon.

11189. "Improvements in apparatus for the conversion of heat into electrical energy." H. H. Lake. (Communicated from abroad by W. E. Case, of America.) Dated Aug. 16. 6d. Claims:—1. In an apparatus for converting heat energy into electrical energy, substantially as set forth, a metal element in comminuted form, combined with mercury. 2. In an apparatus for converting heat energy into electrical energy, substantially as set forth, a liquid from which metal is precipitated and mercury placed to receive said precipitate. 3. In an apparatus for converting heat energy into electrical energy, substantially as set forth, a liquid containing chromic chloride, a carbon element, and an element of tin combined with mercury. 4. In an apparatus for converting heat energy into electrical energy, substantially as set forth, the combination of a vessel containing chromic chloride liquid, and supported therein, a tray containing mercury and tin amalgam, a carbon plate and circuit connections.

11330. "Improvements in the construction of holders for incandescent lamps." C. M. Dorman and R. A. Smith. Dated August 19. 6d. Claims:—1. In a lampholder of earthenware or other incombustible nonconductor of electricity, the method of connecting the conductors to the hooked springs by means of screws tapped into, or nuts screwed on to the outer ends of bolts or studs put through the body of the holder, the hooked springs being soldered or otherwise held in contact with the said bolts or nuts at the back of the boss of the holder, substantially as described and shown. 2. The combination of a combined metallic claw and baseplate, with a boss made of earthenware or other incombustible non-conductor of electricity, having a central hole through which the conductors are brought and coupled up on the front, the boss being attached to the baseplate by screws or rivets passing through the boss, and screwed or riveted into the baseplate, substantially as described and shown. 3. The improved incombustible lampholder as a whole, substantially as described and shown.

11674. "An improved method of suspending and protecting from injury or breakage incandescent electric lamps when used for mining or other purposes." M. Bailey and J. Warner. Dated August 27. 8d. The inventors mount the lamp in an elastic seating within an outer globe, said seating sufficing to maintain good electrical contact between the leading in wires of the lamp or holder, and the terminals mounted upon the cover or support for the same. At the same time the said seating provides a perfectly elastic method of suspension protecting the filament of the lamp from shock or vibration, and thereby preventing its rupture and prolonging its life. Another part of the invention consists in enclosing the lamp, mounted up as described, in an outer globe having an aperture at its base or other convenient part. This outer globe is charged through said aperture with gas, air, or any fluid or liquid, suited to the purpose and then sealed off in the usual manner. The claims are 5 in number.

12019. "Improvements in electro-magnetic motors." H. Hartig. Dated September 5. 8d. Consists in causing the armature to be attracted in the direction of the axis of the electro-magnet so that the whole pole surface acts on the armature. The claims are 3 in number.

12040. "Improvements in and in the manufacture of electric cables, and in means or apparatus to be used in the said manufacture." H. Skerrett. (A communication from abroad by J. H. Dalzell, of America.) Dated September 6. 8d. Relates to a method of making lead covered cables in continuous lengths. The claims are 14 in number.

12189. "A method of and apparatus for the electrical transmission of sound." H. H. Lake. (Communicated from abroad by E. E. Graves, of America.) Dated September 8. 8d. Consists in actuating the diaphragm of a telephone by an electro-magnet and armature, the latter being loosely in contact with the diaphragm. The claims are 2 in number.

12190. "Improvements in telephonic apparatus." H. H. Lake. (Communicated from abroad by E. E. Graves, of America.) Dated September 8. 6d. Relates to improvements in detail in the apparatus described in specification No. 12,189. The claims are 6 in number.

12406. "Improvements in or relating to electrical type-writers." A. J. Boult. (A communication from J. F. McLaughlin, of America.) Dated September 13. 11d. Relates to an automatic reverse movement and spacing mechanism for electrical type-writers and consists in certain details of construction arrangement and combination of parts. The claims are 17 in number.

13245. "Process and means for placing railway trains in communication with an electric conductor separate therefrom." E. Graefe. Dated September 30. 6d. Claims:—1. A process of connecting a railway train with an electric conductor outside thereof and separate therefrom for the purpose of enabling electric communication to be made between the train and a station in front of or behind it, and messages and signals to be made to and from the train, for which purpose a liquid that is a good conductor of electricity is caused to flow over the outside conductor, substantially as described and shown. 2. For carrying out the process referred to:—An apparatus consisting of a battery; a container for a liquid that is a good conductor of electricity, provided with discharge pipe; a peculiarly formed trough for the reception of the outside conductor with suction pipe, which latter is in communication with an injector or other lifting medium for raising the conducting liquid; a vessel for receiving the conducting liquid from the suction pipe; and a return supply pipe to the container, substantially as described and shown. 3. Instead of the separate conducting wire and trough, the arrangement of a fixed conducting wire having the form of a trough or gutter for receiving the conducting liquid from a pipe, substantially as described and shown.

CORRESPONDENCE.

Fire Office Rules.

"Electrical Contractor," in his letter of the 16th inst., puts the question of fresh insurance rules in a very forcible manner.

I do not think that there is the least doubt that if only electrical contractors as a body had been consulted, they would have given an unanimous verdict against the issuing of fresh rules, or interfering with those that have so long held the field.

These new rules are solely attributable to the unsuccessful attempt on the part of the Society of Telegraph Engineers to obtain for themselves the credit of having originated the only recognised insurance rules in existence. If there is a clique who seem to have tardily discovered the fact that they have had no hand in the issuing of these rules, and have any objections to them, why do they not come forward and state those objections? If they did this, I feel confident that the Phœnix Company would be only too glad to entertain any reasonable suggestions they might make in order to render their rules as perfect as possible. This issuing of fresh rules will create the utmost confusion, especially amongst good and first-rate firms, who will be cut out altogether by those who will take advantage of a multiplicity of rules to put up cheap and bad work, besides unnecessarily alarming the public, who will immediately take it for granted that if electricians cannot mutually agree how to put up installations, there must be very considerable danger run in adopting the electric light.

In future how are specifications to be drawn up for installations? Which set of rules will be taken as a basis of the way in which the work is to be executed? Supposing a building is fitted with the electric light and insured in several offices, each having its own set of rules, how will it be possible for the contractor to get his work passed by the various insurance inspectors if each is going upon his own lines? Hitherto, where a case has arisen as above, it has nearly always been sufficient to inform the other insurance offices that the installation had been put up in accordance with the Phœnix Fire Office Rules, and passed by Mr. Heaphy.

Now all this will be changed, and contractors will have a sorry time of it. Consulting electricians will also be powerless to better the situation, as they cannot hope to get rival promoters of rules to agree to any but their own.

This question is of such momentous importance to all electrical firms that unless a combined movement be made, and that at once, to counteract this action, a blow will be struck at our industry from which we shall suffer long and severely.

As it seems to be a question that only concerns electrical contractors, and not telegraph engineers, professors, or other learned scientists, the former should at once take steps to bring forward their united opinions, and in so doing I hope there will be many who will share the views of

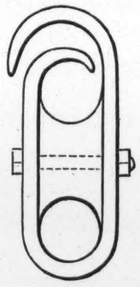
Another Electrical Contractor.

March 20th, 1888.

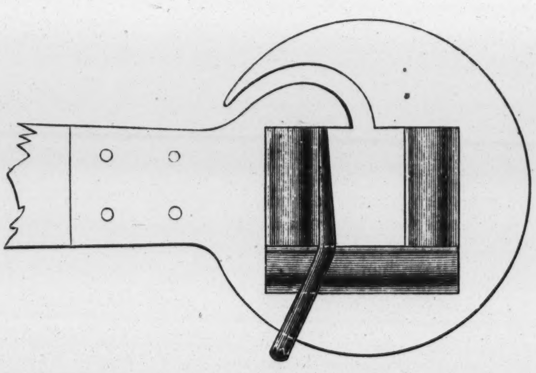
Renewal of Aerial Line Wires.

I am amused at the sarcasm and lack of practical knowledge displayed in your issue of the 16th inst. I observe the idea has been grasped, but not much ingenuity shown after the test outline, in improving the formation of the prongs.

This might answer better and not be laughed at—



But my favourite device, which has been in mind a long time, is on the roller principle, something like this:



and which I intend when time permits bringing into practice in connection with the lever illustrated in the Review of the 24th ult. But the wire will always be, when practicable, laid out in the usual manner, *i.e.*, by carrying the drum. The rollers are merely to avoid undue friction when straining the wire round curves.

I would add that with the most careful system of levelling there is apt to be a little upward pull, and therefore it is right and important, when designing a tool for the renewal of the wires, this should be taken into account.

It may not occur for miles, and the most likely positions are over bridges and tunnels; but, of course, all depends on the tension of the wire.

By not considering upward pull, we may as well employ screwless and uncemented insulators, with the result that some day we would find the cups off their bolts and suspended in the air.

Electrician and Engineer.

March 17*th*, 1888.

The Swinton Intercommunication System.

My attention has been called to the paragraph under the above heading in your issue for the 9th inst., and I have now had an opportunity of reading the article in the *Western Electrician* referred to, describing the intercommunication system of the Western Electric Company, of Chicago, with which system I was not previously acquainted.

The similarity between this system and my own arrangement, as described in the ELECTRICAL REVIEW for January 27th, is more apparent than real, the most important difference being that whereas in the Western Electric system a separate battery is required at each station, and an extra battery for calling purposes, making for ten stations eleven separate batteries, with my arrangement only one battery is required for any number of stations, and this single battery suffices for both speaking and calling purposes, the advantages and greater simplicity of my arrangement being obvious.

The Western Electric Company's system is, moreover, based on the employment of telephones using induction coils with primary and secondary circuits, which is not the case with my arrangement, and the plan of connections used in the two systems at the individual stations differs very considerably.

A. A. Campbell Swinton.

March 14*th*, 1888.

Electrical Traction.

I notice in your issue of the 9th inst. a paragraph referring to Mr. W. J. Carruthers Wain's firm conviction that electricity as a motive power is destined to supplant every other kind of traction upon town tram lines. I have only this week returned from a tour of inspection, on behalf of the Series Electrical Traction Syndicate, Limited, of most of the prominent electrical systems in operation in the United States; and in answer to your invitation to contractors, I should like to state publicly, through the medium of your widely-read columns, that this company is prepared to give practical proof that electricity can be applied to tramways at a price which will leave horses no chance. The patents under which we shall work permit the motors to be simply and efficaciously run in series with one another, and secure us the exclusive right of so running them. It is a matter of easy calculation to show conclusively that the cost of running cars in series direct from a main generator is about half that of running by means of accumulators. The difficulty hitherto has been to devise such a series system as shall work with mechanical perfection. The patents now under our control, however, surmount that difficulty; and we are at the present moment in the course of making arrangements to equip a line to prove the truth of our assertion.

In comparing the relative cost of various systems, I purposely omitted mention of multiple arc running, as I take it no contractor would be prepared to guarantee even a moderate efficiency on this plan over a system of any length with a reasonably large number of cars. A striking fact in support of this statement is that no American contractor for any multiple arc system, so far as I am aware, has ever ventured beyond eight cars. No contractor, if the choice rested with him, would confine himself to short lines with few cars, when he might equip a long line with many cars; and that there is no deficiency in the demand for long lines is certain. I have been assured by representatives of two large American tramway companies that they would gladly pay large sums to have their lines completely equipped, provided they could find a contractor to guarantee successful running.

I also see in the same issue of your paper an amusing paragraph containing a communication of Mr. Wm. Wilkinson's to *Engineering*. One would really think that tramway engineers in the year 1888 could hardly fail to be aware that the ascent of a given gradient with a given load is simply a question of the power available. When Mr. Wilkinson speaks so pityingly of electric motors compelled to face a gradient of 1 in 11½, it would seem that he is ignorant that electric locomotives of any desired power can be built with far less weight than steam locomotives of the same power. As a matter of fact, I have seen an electric tramway in the United States carry loads of 80 passengers up a gradient of no less than 1 in 8. In another case, where the motors ran in series, gradients were climbed of 1 in 13.

The importance of the subject, and the great interest I know you take in it, must be held my excuse for occupying so much of your valuable space.

Edward Manville,
Engineer to the Series Electrical Traction Syndicate, Limited.

March 14*th*, 1888.

Aluminium Alloy for Small Cut-out Fuses.

Some years ago I read a paper before the British Association (Southport Meeting) on the heating effects of electric currents, in which the cooling effect of the terminals of cut-outs was, I believe, pointed out for the first time. My object in mentioning this is to recall the fact that at the time I recommended aluminium alloy as a suitable material for small fuses. It is preferable to platinum, which I see Mr. Preece advocates, in that it is much cheaper, and has the same advantages of not deteriorating or melting with an explosion. Cut-outs have been discussed *ad nauseam*, but I am surprised to find that the position of these much abused fittings has not been fixed. If placed on the switch they are a source of "possible" bad contact; if fixed near the main leads, they cannot be got at to replace and therefore must never act; they are not allowed under the floors, and are hardly ever placed, where I think they should be, in an accessible position obtained by diverging the main lead so as to run all the branches from one spot through their particular cut-outs.

The German Fire Risk Rules in use in Berlin are to be commended for their practical character and brevity, and I think it would be quite worth while for those who are responsible for our English regulations to visit this city and see for themselves how the problem of supplying a constant service of some 30,000 lights has been accomplished to the satisfaction both of the consumers and the fire insurance offices who *reduce their premium* where electric light is used.

Killingworth Hedges.

Berlin, *March* 13*th*.

Magnetic "Resistance."

Let me add another to the objections which your correspondents, Dr. Fleming and Mr. Swinburne, have urged against the adoption of "resistance" as a scientific term in magnetism. I assume the word to be employed, in the sense of specific resistance, to express the ratio of the magnetising force ($\mathfrak{H}$) to the magnetic induction ($\mathfrak{B}$). Now the ratio of $\mathfrak{H}$ to $\mathfrak{B}$ is not only not constant (as your correspondents have said): worse than that, it is not determinate. On account of hysteresis in the relation of magnetic induction to magnetising force, we may have any one of a host of widely different values of $\mathfrak{B}$ associated with a given value of $\mathfrak{H}$; or, again, we may reach an assigned value of $\mathfrak{B}$ by various paths, involving wide differences in the values of the magnetising force under which the assigned induction exists. If magnetic resistance is to be analogous to the resistance of an electric conductor, we must find a circuit in which the current depends not simply on the existing electromotive force, but on the values the electromotive force has passed through before the existing value is reached. The analogous electric circuit would be one from which we could remove the electromotive force and still have a part of the current persisting in its flow—a circuit in which we could predict the current a certain electromotive force would maintain only when we knew the whole history of the past electromotive forces that had been at work. I do not think that in such a case it would help us much to speak about the resistance of the circuit. If actual circuits behaved in that way we should probably never have heard the phrase.

The term magnetic permeability, the reciprocal of which we are now asked to call magnetic resistance, has not the simple meaning that this invitation would imply. It is the ratio of magnetic induction to magnetising force in a very special case—namely, when the material has no magnetisation to begin with and the magnetising force is applied so that it increases continuously from zero to the value at which the permeability is specified.

The phenomena of magnetism are complex enough to require study and expression by themselves. It does not mend matters to use language that suggests a false, or, at the best, a very imperfect analogy. Rather than slur over differences, we should aim at keeping the terminology of magnetism distinctive as a help towards making its definitions rigorous.

J. A. Ewing.

Dundee, *March 17th*, 1888.

The Brooks System.

The article in your issue of February 10th has now my consideration, and the points upon which "Conductor" wants information will be briefly answered. There are two windings of cotton upon each conductor, 53 conductors in all, No. 16 American gauge except one in the centre, a No. 18 gauge with coloured covering, which is used as a test wire, the others in splicing were connected inside wires with outside wires promiscuously. The wires are twisted together tightly so as to have a turn in every 18 inches of length, the group or cable has a diameter of about 1⅛ inches. Over the cable there is a heavy braid of hemp, making the entire diameter 1¼ inches.

The cable is coiled into a cauldron and covered with rosin and rosin oil, in bulk about half and half of each. The cauldron is on wheels. We move it to the point where the cable is pulled into the pipe, place a fire under the cauldron, heat the contents to 360 Fahrenheit. While in that temperature the cable is drawn into the pipe by means of an iron rope and a capstan.

When the lengths of iron pipe are screwed together, there is a half pint or more of powdered caustic lime turned into each socket or coupling, which is in the form of a T, having a screw plug ½ inch in diameter.

The powdered lime keeps the inside of the pipe perfectly dry until the cable is drawn in. The lime also keeps the cable from adhering to the pipe, as the compound rosin and rosin oil is exceedingly sticky. If it happens to be raining and drops should strike the cable they are immediately turned into vapour and pass away, doing no harm, as this operation is performed while the temperature is at the point before stated.

When the cable is hauled in we heat the compound in a smaller cauldron to 400 Fahrenheit and pour it in at the plug holes in the sockets until the pipe is full and all air expelled. This is the way we keep the cotton covering dry. If any of your readers desire a more detailed description, I recommend them to invest a sixpence at the Patent Office.

A thicker single winding of jute or manilla answers as well as cotton.

Few are aware how high an insulator any vegetable textile covering is when it is deprived of moisture. Placing one of these cables in an oven and testing one of the wires with all the others connected to earth, and at a temperature of 350 Fah., the insulation is enormous; while all ordinary insulating substances at that temperature become conductors comparatively. In experiments to ascertain what vegetable covering is the best insulator, linen proved highest when deprived of moisture, and the poorest in its natural condition, or, in other words, it has the greatest affinity for moisture. Is this the reason we find sheets of this material delightfully cool in hot weather, while they cannot be used at our seaside watering places because they get so damp?

About the "contention" of European electricians, &c., "which Mr. Brooks misunderstands," Silvanus P. Thompson wrote an article on long distance telephony in which he undertook to show that with a less sensitive receiver and more powerful transmitter, long distance telephony would be practicable. Mr. Preece took issue with him and brought up the principle that the resistance of the conductor multiplied by its electrostatic capacity was a measure of telephonic transmission. Others took up the discussion which became hot and heavy, so much so that I trembled for the result, fearing that my friends abroad would resort to the Marquis of Queensberry rules before coming to a satisfactory settlement. Oliver Heaviside, referring to that measure of speed in working cables as being applicable to long distance telephony, said "it would not do to jump from the particular to the general."

"Conductor" is amused that I should state that a 14 gauge is no better than a 20 gauge for ordinary telephonic purposes. The telephone managers in New York and Chicago have come to the conclusion that the smaller wire is the best, and this statement may possibly further amuse "Conductor." I like to see people amused.

Rosin and rosin oil mixed is nothing more than shoemaker's wax, which Prof. Tait and Sir William Thomson call a liquid; Thomson in his lecture on the wave theory of light, and Tait in his work on the properties of matter refer to the experiment of bullets when placed on the top of it and corks underneath, saying they will pass each other, the corks coming to the top and the bullets going to the bottom. They call this mixture a liquid. "Conductor" speaks of it as "trickling." Liquids do not check and crack, and this substance is sufficiently liquid or fluid in all temperatures to preserve these qualities. Another admirable feature of this substance is that it is much heavier than water. When the splices are covered with the mixture, if there is sufficient space above in the splice box, you can turn in a quart of water without affecting the insulation. Paraffin does not posses this quality; it is lighter than water, checks and cracks, especially when encased in lead, by coiling and uncoiling. Here is a "wrinkle" for Berthoud and Borel.

Eight years since my son laid a cable across the Delaware River—lead encased and armoured, containing 50 conductors—not a wire has failed up to this day. He used rosin softened with paraffin oil. This cable stood longer than any other cable that has ever been laid across this river to connect Philadelphia with Camden, although very many have been laid there during the past 30 years.

In drawing in the cables before referred to, not a conductor was broken or brought in contact with the iron pipe, nor was the outside braid torn or injured in the least.

"Conductor" wants facts upon which to base an opinion. The more he studies into it, the better he will like it. There are two more candidates for knowledge who have paid me their respects in your journal of the 17th. They do not state that they desire knowledge, but give abundant evidence that they are sadly in need of it.

(Signed) **David Brooks.**

Philadelphia, *March 6th*, 1888.

The contribution from "W" in the Journal of the 17th, shows a nervous sensitiveness about my use of rubber sleeves to prevent the effects of moisture gathering upon the textile covering where it is exposed at the terminal. India-rubber is repellant of moisture, and the three inches or so whenever it becomes soiled from use, can be replaced with a fresh piece. Now as I am in the line of producing exceptionally foolish quotations, I will quote from myself without regard to the sensitiveness of my rubber friend. The last paragraph of my original article is as follows:—"It was not the intention of the Pennsylvania Railroad Company to use these wires for telephone purposes. Fifteen telegraph conductors have been connected into the cable, and upon some of those conductors are operated with 130 cells of battery at Broad Street Station in connection with dynamo currents at Jersey City. After all the telegraph conductors had been connected and working, some of the telephone circuits were connected in the cable experimentally, and those who use the telephones say they observed a marked improvement; and with these results all the telephone circuits are now brought through this cable, and each party using telephones makes the same favourable report. It should be borne in mind that they were previously in a special cable used for telephone purposes only, and although the rattle caused by the telegraph is observed, speech itself comes much more distinctly articulated."

I can qualify the foregoing statement, and instead of saying "special cable," will say special rubber cable. I will say for his benefit that rubber is a good insulator, especially when drawn out in the shape of a wire, and tested from end to end.

The Edison Electric Light Company of this city are laying their conductors on a system by which the conductors have to be spliced at every joint of the pipe, say once in every 20 feet, and this operation is tedious and expensive. We can draw in those conductors in lengths of a thousand feet, and get at them for distribution for house to house purposes by the unscrewing of two joints. The cover to Edison's box is what is called a flange-union, fastened by screw-bolts and nuts.

We can see no advantage in soldering the joints in a telegraph or telephone conductor when rosin and rosin oil are used as an insulator, for these substances have no effect upon copper, and for the same reason we see no advantage in having the wire tinned, but under other circumstances I should prefer to have the wire tinned.

In Chicago we put 510 conductors in a three-inch diameter pipe. In this case rosin oil alone was used, and one person made the 510 joints in less than eight hours after having had a little practice.

In the test of November 30th by Griffin, he says calling it one division for the four conductors would have made it 583 megohms, but he obtained no sensible deflection, so you can make out just what you please about it for that test.

The test by Carl Hering was with all the 53 conductors bunched, and the deflection in that case is not as great as that of the sum of the conductors when each is taken separately with all the others connected to earth, as anyone familiar with the business will understand.

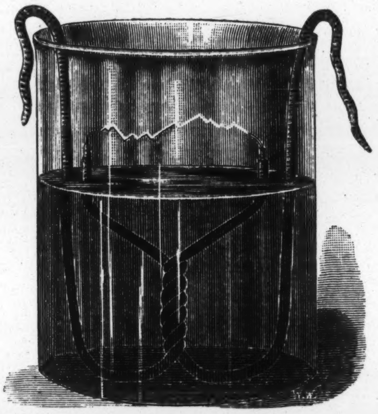
At this date every circuit that has been connected into that cable remains so connected, and with the wires that are being used for telegraph purposes we cannot get any reliable deflection, owing to the disturbance from currents upon neighbouring conductors.

There are about 20 spare conductors now in the cable. The electrostatic capacity is $\frac{24}{100}$ths of a microfarad for the 7,009 feet, or $\frac{18}{100}$ths per mile with the conductors not in use connected to earth. With these figures for electrostatic capacity and the formula, page 352, Culley, eighth edition, the different conductors vary from 1,000 to 5,000 megohms per mile, and this difference I attribute to the different sizes of the "phantoms" in the splices. My English friends have written a great deal about splicing, and the best way to get rid of those "phantoms."

With this I send to the editors of the REVIEW a section of the cable which, as stated before, has a diameter of about $1\frac{1}{8}$th inches. Now could any more than 10 gutta-percha insulated conductors, such as used by the Post Office, be got into that space? If I remember rightly, the electrostatic capacity of those conductors, when laid in cast-iron pipes, is about four-tenths of a microfarad per mile. With these facts, or the true figures whatever they are for the gutta-percha, please make a calculation of the difference in the electrostatic capacity of the two different insulating materials.

As to the cost of the materials, I will give a few figures. The rosin we use is the cheapest quality, dark coloured, and heavy, costs $1.50 per barrel. The oil is the last run of the still, the cheapest and heaviest, costs eleven cents per gallon. With these figures and the price of jute, please see how much you can reduce the electrostatic capacity, which is such a factor in fast speed telegraphy and long distance telephony.

I will conclude this article by suggesting an experiment. Take two pieces of cotton-covered wire, twist them together as shown in this figure, boil them in a mixture half-and-half rosin and rosin oil to a temperature of 360° Fah. Before the liquid becomes cool, turn it into a glass jar and place the twisted wires, as shown in the figure, attach the poles of a dynamo to each of the exposed ends. The insulation between the wires is not affected by the full force of the current. After you are satisfied with dynamo experiments, try it with the Holtz machine of a potential of 50,000 volts, more or less, and it will be found that the current will spark across an inch or more through the air before it will go through the insulation where the conductors are twisted together, although they are not separated at that point one-eighth of an inch, and the thicker the covering of the wires where twisted, the greater the distance the spark will go through the air.



David Brooks.

Philadelphia, *March 9th*, 1888.

Fire Alarms.

I am a thorough believer in the utility of fire alarms in our streets, but if the authorities put them in some obscure corner when splendid open sites are available in the immediate vicinity, it appears to me that half their value is lost. I know, for instance, that one of these alarms was erected last summer *somewhere* within a stone's throw of my house, but to this day I am ignorant of its exact locality, and should probably never have heard of its existence at all but for a neighbour's growl that the wire passed right over his tennis lawn. Surely there is something wrong somewhere in connection with this matter.

A Black Heathen.

March 19th, 1888.

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